TECHNIQUE AND TRAINING-INDUCED INJURIES IN'ROWING

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Although rowing is a non-contact, low-impact and non-weight-bearing sport, it is not without injuries. Most of the rowing related injuries can be attributed to cumul;ative stress placed on particular areas or systems of the body by the improper performance of the competitive pattern of movement or training regime. As well, research regarding prevention nd treatment of rowing-related musculosceletal injuries has not kept pace. Little has been published on the etiology and pathology of rowing related injuries. With this is mind, the dual purpose of this paper is to identify tho common muscolosceletal injuries associated with rowing, and to examine possible contributing factors.

The rowing stroke is usually diivided into four basic phasis which, when combined one after another, will comprise the whole stroke cycle. Tlie four phases include: the release, recovery, catch,and drive phase. The release occurs as the blade of the oar is extracted from the water. The recovery occurs as the blade as well as the the rower move toward, and prepare for the catch. the catch occurs as the blade iss placed in the water and is followed by the drive phases that the majority of injuries occor (Green, 1980).

Tlie Injuries of Rowing. Involvement in any sport has inherent risks of injury. Indeed, a predictable set of musculoskeletal injuries can be demonstrated in most sports. The typical rowing injuries include: lumbar and thoracic back pain (LTBP), stress fracture of a rib (SFR), chondromalacia of the patella (CP) and extensor tenosynovitis of the forearm (ETF).

LTBP- Tlie most common complaints by rowers are lumbar and thoracic back pain. This malady results in the highest volume of referrals to the physical therapist (Wajswelner, 1987). The incidence of LTBP.has increased over tlie past 20 years. This increase may be attributed to two factors:

1.) the current stroke teclmique used by many rowers (Green, 1980; Stallard, 1980);

2.) the popularity of physiological conditioning practices of high pressure (speed) and low cadenceflligh pressure training (Green, 1980).

The modem style of sweep rowing began to develop in tlie early 1970s and still has many proponent today. It accentuates the anterior flexionb and rotation of boththoracic and the very limited extent lumbar vertebrae at the catch position in contrast to the straight back swing that was previously thaugh. In the catch position the lumbar spinae is flexed forward with tlie athlete,s knees near his/her axillae and the slioulders rotated to remain parallel to the oar handle (Green, 1980). While the oarperson is in this position the boat is unstable and many laterally oscillate (roll), adding lateral bending to the s[ine that is already flexed forward and rotated. During this critical period the oarperson attempts to aply large forces onto the oar while the lumbar spine is at the limit of its movements with tlie annulus fibrosus and spinal ligaments fully streched and the facets of apophysial jounts in tight opposition (Stallard, 1980). Any lateral movement of the boat at this time may strain the lumbar spine causing ligament and joint capsule injury. In addition, any instability (inadequacy(resulting from ligament or joint capsule injury may facilitate further injury. With the lumbar spine in a flexed, rotated position, the oarperson is expected to apply large forces onto the oar handle. this creates large shear forces at the joints of the lumbar spine (L4/L5, L5/S1). While these shearing forces can, on their own, cause prtrusion of the intervertebral disks at these joints, this possibility is greatly increased in joints with compromised stability.

Green (1980) has suggested that changes in the technique of rowing was an attempt to accommodate technological changes in boat construction and rigging. Most important, the sliding seat apparatus was re-designed to allow for more forward movement (6 inches or more). This necessitated higher positioning of the feet in the boat which permitted ah increase the drive of the legs and allowed for full extension of the legs. An efficient stroke involves placing the thoracic and lumbar spines in anterior flexion and rotation at the catch position to accommodate the longer slide traverse and higher foot position. Although the authors could not find any published evidence for rowing-related thoracic back pain, one would anticipate that this injury is associated with modem technique.

Treatment for the injury includes rest. However, this does not always relieve the pain and, in fact, exercise sometimes is of benefit for pain relief (Stallard, 1980). Usually rest in addition to ice will settle most of the acute pain. Physical therapy often assumes a more prominent role in the management of local muscle spasms and lumbar manipulation (lumbar sprain) which may be prescribed to reduce pain and to strengthen supporting muscles.

Advanced rehabilitation should involve a progressive re-introduction to rowing through rowing ergometers, followed by sculling. The skill of sculling involves using two oars, enables the athlete to balance the craft more efficiently, therefore, less rolling of the craft, reducing the degree and magnitude a lateral flexion of the lumbar spine. Once the athlete begins to row. he/she should perform a specific routine of stretches (3S) for the musculature of the lumbar spine every morning and evening as well as before and after each training session. Exercise prescription specificity designed to strengthen the supporting muscles of the lumbar spine and the hamstring musculature have been suggested to reduce injury (Green, 1980; Stallard, 1980).

Also, if introduced to sculling before rowing, the basics can be taught in boat handling and balance whch may help to avoid unnecessary lateral boat motion while performing the modern rowing technique. A staight back swing technique with less lumbar flexion should be encouraged during rehabilitation, thereby, decreasing the occurrence of LTBP with no appreciable sacrifice in training.

SFR Although not as common as LTBP, a stress fracture of the rib is an injury that can be attributed to modern training methods. With the introduction of the high pressure and low cadence/high pressure training methods, more stress is placed on the thorax.

The most common rib experiencing a stress fracture is the ninth. Holden and Jackson (1985) attributed the fracture to be the large amount of stress placed on the posterolateral area of the ninth rib by the serratus anterior muscle. Forces generated primary by the serratus anterior retract and protract the scapula, however, when the scapula is stabilized or fixed, the serratus anterior tends to elevate the ribs. As the blade enters the water, the oarsperson attempts to generate maximum force on the oar handle. At this time, the shoulder girdle and scapula are fixed in order to efficiently transmit the force from the foot boards to the oar. Since the scapula is fixed, the ribs tend to be stationary, the large forces exerted by the serratus anterior creates a great deal of bending stress on the ribs. At maximum efforts, the additional forces by Valsalva or exhalation, have the potential to cause a stress fracture. This injury has been predominantly found in scullers (Holden and Jackson, 1985).

A stress fracture is usually mis-diagnosed as thoracic back pain (Holden and Jackson, 1985), but when the fracture is discovered, it will respond well to simple conservative measures, such as, ice and rest, and the athlete may return to rowing within four to six weeks.

A preventive measure that can be taken in order to avoid such an injury would be proper, carefully planned training. According to Holden and Jackson, (1985) the primary etiological factor are errors in training (ie., sudden introduction of speed or high pressure training and weight training), if these are properly administered, the potential for injury may be decreased.

CP: Chondromalacia of the patella is referred to as "rower's knee" in rowing circles. It involves the inflammation **and/or** lesion of the articular cartilage of the underside at the patella usually due to patellar tracking problems.

Sweep rowing involves a high degree of knee flexion with large forces acting on the patella by the quadriceps tendon since the quadriceps are a prime mover during the drive phase of the stroke. This. combined with a technique (modem) that places an emphasis on the outside knee (the **knee** opposite side from the oar) being pushed laterally to allow the outside shoulder to sweep between the knees while keeping the shoulders parallel to the oar handle. With the knee being away from the midline, the straight line of pull is comprised and the quadriceps will tend to pull the patella medially. As the patella is pulled away from the midline of the knee, it may rub on the medial condyle of the femur increasing the susceptibility for inflammation, lesion and pain.

There are many treatments for chondromalacia of the patella, but no one reliable cure. Total excision of the patella. chondral shaving, lateral release, muscle realignment, **tibial** tubercle re-implantation and arthroscopic lavage are some of the treatments for this problem.

However, the current technique taught makes it difficult to avoid such problems. Efforts can be made to restrict the amount of the lateral movement of the outside knee. Also, those that prove to have predisposition to the injury (especially adolescent females) may be better suited to sculling rather than sweep rowing.

ETF - Tenosynovitis of the radial extensors of the **forearm,** or "fire paw" is caused by a faulty stroke technique. Aggressively gripping the oar with a "death grip" may injure the relatively small extensor and flexor muscle groups of the forearm (Williams. 1977). A loose grip during the entire stroke cycle can prevent such forearm injuries. In turbulent winds and water, the rower may attempt to loosen the grip during the latter stages of the recovery.

A hypothesis for the etiology of selected rowing **injuries.It** has been suggested that with the recent increase and the widespread use of cross training methods, there will be a corresponding increase in the numbers of new (nontraditional) ortliopedic problems (Green, 1980; Stallard. 1980). It is the opinion of the authors that, at least in North America. this has been with us for some time, and only now are some coaches beginning to realize the influence training methods have on the long-term **health** of their athletes.

The evidence: A survey of elite rowers: Accounts from a survey of 50 elite rowers (26 males and 24 females) reinforce the above hypothesis. A questionnaire-style survey was conducted during the 1994 February training camp of the Canadian Rowing Team in Victoria, BC. Female subjects ranged in age from **18** to 30 years, males from 19 to 34 years. Subjects were asked whether a physician had ever diagnosed them with any of the selected injuries discussed above. If the subject responded positively. the subject was requested to identify and explain the contributing factors as determined by a physician.

72% (36) of the elite rowers attending the camp had one of the selected injuries at some point in their career. Six rowers (5 females. 1 male) identified multiple injuries. In addition, all thirteen current or former World or Olympic Champions surveyed identified at least **1** of these rowing injuries. Thirteen females reported LTBP; 2, **SFR;** 3, CP and 5 with **ETF**. Ten males reported LTBP; 1, **SFR;** 2, CP and 6 with ETF. Table 1 shows that the most common contributing factors as explained to the athlete by their physician were craft specialization, over-training, on-water training methods, technique flaws and off-season heavy resistance training (ie., weight training). In most cases, training was interrupted resulting in a decrease in performance.

Injury	Contributing factors					
	a	b	c	d	e	f
Males						
LTBP	5	3	1		1	1
SFR				1		
CP					1	1
ETF	2				4	
Females						
LTBP	4	2	6			5
SFR			2			
CP					2	
ETF		2			4	2

a-Specialisation, b-Over-training, c-Training methods (power/speed)
d-Equipment, e-Technique, f-Weight training

Notes: Specialisation refers to emphasis on limited forms of rowing (ie. port side sweep, starboard side sweep, sculling) leading to possible muscle or stress imbalances, over-training refers to overstressing the musculoskeletal system, training methods refers to "power rowing" - maximal pressure (applied force) at very low rates (cadence 16-18 stroke per minute) and "speed work" -greater than 100% of race pressure, equipment refers to stiff boats and oars, technique refers to flaws in technique and weight training refers to off-season maximum resistance training (eg., 1-RM).

Finally, when these athletes were asked to priorize the components important to performance in rowing, equipment was ranked first, natural growth and development of the mind and body, second, and most significantly, all of the interviewed athletes evaluated technique/physiological conditioning, third, and least important.

CONCLUSION

Proper stroke mechanics and a well organised training program can help athletes avoid unnecessary injury. Streching spacific problem areas such as, the back and legs are useful preventive measures. Reducing the mechanical stress on vulnerable muscle groups by paying attention to proper rowing technique is recommended. weight training is not.

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