BAT ROWING
INNOVATION
R&D NOTE

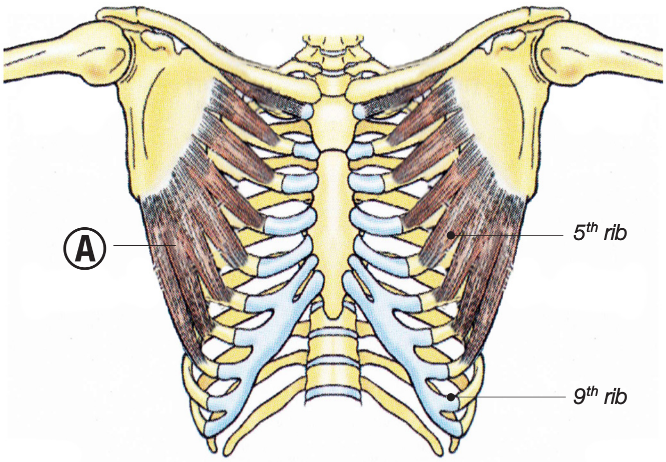
Number 11 Bioseries™

Rib stress fractures: Part 2

Welcome to part 2 of our R&D Note series on rib stress fractures in rowing. In this note we start focussing on the mechanisms of injury.

Location of injury

The incidence of rib stress fracture is highest along the antero-lateral (frontal side) and postero-lateral (behind the side) region of ribs 5-9 (See diagram). This is along the insertion of the serratus anterior muscle. Most rowers will experience the stress fractures on one side predominantly but they can occur on both sides with repeated injury.



Known causes and influences

We have discussed some of the key the forces at play (see R&D Note #10) but the key proven factors of rowing rib stress fractures are increased long distance training and heavy stroke loading. It is worth noting that heavy stroke loading also occurs with increased rates over short distances.

Due to the region of rib injury, the main muscular cause of the micro trauma associated with the fracture is reported as the serratus anterior ((A) on the diagram) and its relationship with the external oblique muscle, into which it blends.

A much less common rib stress fracture occurs on the first rib, the cause of which is repetitive stress from contraction of the anterior scalene muscle (a muscle on the side of the lower neck) and bending forces. It is very similar to stress fractures caused by coughing, although the causative factors listed above will again be very relevant in this case.

There are also some key technique findings with rowers who have suffered stress fractures. These include a higher seat velocity, higher speed of initial drive phase with lower knee-extension to elbow flexion strength ratio (meaning a lot of power is coming from the arms relative to the legs) and a pronounced layback position at the finish.

The villains?

The key villains tend to be Serratus Anterior ((A) in the diagram), the external obliques and latisimus dorsi (the lats).

The serratus Anterior attaches to the external surface of the lateral ribs 1-8 and into the anterior surface of the medial scapula (inside of the shoulder blade against the ribs). It holds and rotates the shoulder blade on rib wall e.g.- punching, reaching out, pushups

The External Obliques blend with the serratus anterior muscle above. They attach to ribs 5-12 inserts into linea alba (midline in abdominals- the spilt in a six pack), pubic tubercles and the anterior iliac crest of the pelvis, also invests with rectus abdominus (6-pack muscle) and the transverse abdominus that attach to the ribs 5-12. The external obliques aid with breathing as well as being key to flexion and rotation of the trunk

The Latisimus Dorsi is a very strong muscle with many roles in stability and strength. It attaches to the lower thoracic spine, thoraco-lumbar fascia, iliac crest, ribs 8-12 and inserts into the humerus (upper arm bone).

Between these three muscles we have some of the key mechanical stress forces pulling on the ribs during the rowing stroke. Common characteristics of these muscles include the level of influence exerted on them by the lower limb and pelvis and the influence they have on the shoulder (although less pronounced with the obliques).

The micro trauma that causes stress fracture is itself caused by excessive and uneven forces, including those applied by these three key muscles resulting in asymmetrical/excessive loading of ligaments and bones. Our next R&D Note begins to look at the general picture of how we can begin to address some of these assymetries.

Stay tuned.

The BAT Team

BAT ROWING INNOVATION R&D NOTE

Number 12

Bioseries™

Rib stress fractures: Part 3: Case study / Solutions

Welcome to the 3rd and final R&D Note in our special series on rib stress fractures in rowing. This part of the series uses a case study from our Performance > Innovation work in connjunction with BAT Lab. For more information about either of these areas go to www.batlogic.com.au.

Case study

Our case study subject has a slightly longer left leg that causes a higher left hip. This is much more evident when they are seated in the boat due to the increased load and restriction of the lumbar spine in the seated position. The left hip is higher which already means the Obliques, abdominal muscles (abs) and latisimus dorsi (lats) are functionally shorter on the left side - this increases the tension in the muscles and thus the pull on the ribs that they attach to. Increased tension in the oblique, abs and lats and the resultant reduction in rib movement will cause asymmetry and thus, a changed position of action of the serratus anterior muscle compared to the right (as it attaches to the restricted ribs). Remember this rower has not even taken a stroke yet!

Stroke analysis

When the drive phase starts, the muscles load up and cause an exponential increase in the tension of the ribs and their muscular influences. This causes increased trauma and tension to the ribs. Our subject also presents with some thoriacic spine restriction (very common in rowers) that operates to place more stress on rib movement by restricting their freedom to move in their spinal joints.

General comments

This athlete clearly has an increased risk of rib stress fracture. However, it is worth noting that the analysis findings above are very common not just in rowers but all people: its probably lucky that not all people are putting their body through the stress of rowing! Other sports in which we see frequent rib stress issues (golf, tennis for example) also present with similar issues.

Our review of this athlete began with the mechanics, which demonstrated increased risk. Then we review an overlay of other factors including individual bone structure, sex, biology, nutrition and technique all of which may contribute. It is easy to see why not all rowers struggle with rib stress fractures, while they are the bane of others' careers!

Solutions?

The application of our Performance>Innovation approach led to a number of suggestions on how to best manage the rib stress fracture issues encountered by this particular athlete. We have generalised these below as a guide to areas where proactive action can be taken to alleviate stress and lead to more effective treatment and management of rib stress fractures in athletes suffering a similar range of inputs as our case study subject.

Firstly, to decrease the risk of stress fracture of the ribs we must understand and acknowledge the individual postural and mechanical deficiencies and differences in the athletes body, those of the spine, pelvis, lower limb, shoulder and ribs directly and then plan a solution around these with the additions of technique and equipment adjustment.

Balancing and increasing the stability of the main power generation movements of the stroke was an important first step which required looking at the legs (which account for between 55%-70% of the power produced). Balance and increased stability of the lower limb greatly improved position and function of key influencing muscles mainly by ensuring that power was symmetrically applied and controlled through the athlete's structure. Further, making the great driving power muscles of the legs (gluts, quads etc- see R&D note #11) work earlier and harder reduced the need for upper limb force. This removed some imbalances in upper limb/leg power application, not to mention increasing drive power overall. Reduced injury risk that results in better performance? You bet.

Technical suggestions for reduced risk including applying a slightly truncated arm draw and to decrease the layback position at the finish. These changes decreased the pull on ribs associated with over-working the upper limb muscles (especially serratus anterior) and reducing stress on the thoracic (middle) spine, its muscles and the abdominal muscles. These changes were made more achievable with an increase in lower limb power and stability noted above. More leg and pelvis stability also reduced the contraction of the abdominal muscles needed to stabilize the lower limb and trunk movement throughout the stroke.

With solutions like these, it's never one size fits all. Tailored approaches are always the best.

Our BAT Lab researchers are constantly working to find solutions to eliminate or reduce dysfunction and to harness the existing physiology of the athlete. For more information visit www.batlogic.com.au

The BAT Team