Note to the reader:

In assembling the following excerpts, we have attempted to present the scientific studies relevant to the biomechanical virtues of our pivoting oar handle. Due to intellectual property restrictions, we are not able to supply you with the full text of the articles sited. Also, for readability, we did not include endnotes in the quotations below. We encourage you to read the full text articles at your nearest medical library.

Thank you for your time in reading this review. If you have any questions, please do not hesitate to contact me.

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Backache in Oarsmen

M.C. Stallard, MA, MB, FRCS
Brit. J. Sports Med. - Vol. 14, Nos. 2 & 3, August 1980, pp. 105-108

"At the beginning of the stroke the lumbar spine is in flexion, with the oarsman's knees near his axillae and the shoulders rotated to remain parallel to the oar handle. If the boat now rolls at all, lateral bending is added to the flexed rotated spine and the oarsman is expected to throw his full weight onto the oar in this position.... Therefore as the blade enters the water the lumbar spine is at the limit of its movement with the annulus fibrosus and spinal ligaments fully stretched and the facets of the apophyseal joints in tight apposition. Any upset in the balance at this time will strain the lumbar spine causing ligament and joint capsule injury."

"The oarsmen and women typically complain of a pain in the low lumbar region sometimes radiating into the buttocks or posterior thighs. The pain is felt usually on the side away from the oar -- the outside. If it is felt on the inside, one often finds that the oarsmen has previously spent a long period rowing on the other side."

"One oarsman who was a recurrent attender for treatment prior to rowing in the Montreal Games now sculls at International level. Released from the rotational element by use of two blades, his back has remained acceptable without treatment for the past three years."

Power Athletics Editorial:

When using our pivoting handles, the shoulders no longer need to be kept parallel to the oar shaft, reducing the rotational component of the back by approximately 50%. The hands grip a handle with a central pivot point, so force and leverage of the arms are inherently equal.

We have also met rowers who have been kept from sweep rowing by back pain, but were able to row comfortably when using our pivoting handles.

Do oarsmen have asymmetries in the strength of their back and leg muscles?

Parkin et al.
Journal of Sports Sciences, 2001, 19, 521-526

"Sweep rowing involves the oarsmen loading the back in a rotated and flexed position. This asymmetric activity may lead to the development of muscle asymmetry and injury (Hides et al., 1994; Hodges and Richardson, 1996). It has previously been noted that imbalance leads to a high rate of both injury and re-injury (Marshall and Tischler, 1978; Campbell and Wayne, 1979; Knapik et al., 1990)."

"Left and right asymmetry was observed in EMG activity of the lumbar erector spinae muscle groups during the trunk extension test among the oarsmen. This was significantly related to rowing position."

Power Athletics Editorial:

EMG stands for Electromyograph, which is a tool for detecting muscle activity in subjects. Essentially, it uses a small electrode which is stuck through the patient's skin, into the muscle tissue. By measuring the electrical pulses generated by the muscles, the researcher can determine which muscles are firing and when.

Torque and EMG in rotation extension of the torso from pre-rotated and flexed postures

Sharwan Kumar, Yogesh Narayan
Clinical Biomechanics, 2006, 21, 920-931

"The torque production capacity of the human trunk is posture dependent and declines with increasing rotation. However, with increasing rotation and flexion, the magnitude of EMG increases. This implies that with increasing asymmetry, it requires more muscle effort (thus tissue stress) to generate less torque. Increasing asymmetry tends to weaken the system and may enhance chances of injury."

"....flexion may tend to engender more symmetrical response, rotation modifies it significantly by suppressing ipsilateral external oblique, contralateral internal oblique and latissimus dorsi. This redundancy of some muscles may cause increased load on other spinal muscles, which contract and stabilize. The situation therefore becomes unbalanced and prone to injury."

Rotational Mobility of the human back in forward flexion

R.J. Hindle and M.J. Pearcy
Journal of Biomedical Engineering, 1989, Vol. 11, May, 219-223

"There is considerable controversy in the literature concerning the role of torsion in the production of intervertebral disc degeneration and prolapse. Farfan and colleagues believe torsion to be the most important factor in the initiation of annular damage. They have produced annular ruptures similar to those that occur in vivo by subjecting intervertebral joints to forced rotations. They found that an average of 22.6º was required to produce failure in whole joints with normal discs."

"The mean value of standing axial rotation obtained [in this study] was 29.4º, approximately three times the value one would expect for the whole lumbar spine. In some individuals an increase of up to 20º was observed when in the first seated posture. The majority of this increase can be attributed to increased mobility of the lumbar spine because the orientation of the thoracic zygapophysial joints is such that, even in the upright position, almost unhindered rotation is available."

"Repeated torsional trauma could be expected to lead to a thinning of the articular cartilage. This, combined with the extra rotation available when the spine is flexed, may be sufficient to cause annular damage. Thus, the conclusion of our study is to confirm that the lumbar spine has a greater rotational capacity in a flexed posture than when erect. This implies that the intervertebral disc may be vulnerable to torsion when twisting is combined with forward flexion."

Back Pain in Intercollegiate Rowers

Teitz et al.
The American Journal of Sports Medicine, Vol 30, No. 5, 674-679

TABLE 3
*Reported Events Causing Back Pain**

Event	*N*	Percentage of those reporting that a specific event caused pain (*N* = 196)	Percentage of all those with back pain (*N* = 526)
Outdoor rowing	142	72.4	27
Weight lifting	98	50	18.6
Ergometer training	57	29.1	10.8
Indoor rowing	23	11.7	4.4
Lifting boat	11	5.6	2.1
Other	64	32.7	12.2

* One hundred ninety-six people indicated that a specific event caused their back pain; 52 of these people indicated more than one event causing pain.

> "The results of both analyses showed that ergometer training for longer than 30 minutes was the most significant and consistent predictor of back pain for all age groups and when all potential predictors were considered simultaneously."
>
> "Spine hyperflexion also occurs when the scapular stabilizing muscles are not strong enough to receive the force transferred from the lower limbs or when hamstring muscles are hyperflexible.... To protect the spine, good rowing technique is critical, as are strong scapular stabilizing muscles and strong gluteal and hamstring muscles."
>
> "Preseason strengthening for the back, hamstring, and scapular stabilizing muscles will make possible the appropriate transfer of force from the lower to the upper limbs without breakdown of proper rowing technique and subsequent injury to the spine."

Power Athletics Editorial:

By spending more time training on the ergometer, collegiate athletes are not properly preparing their bodies for the unique movement of sweep rowing, specifically the twisting of the upper body and the load asymmetry between the shoulders at the catch. The ergometer helps them develop significant leg power at the beginning of the drive, but with a standard oar handle, they overpower their upper body causing hyperflexion in the back and leaving it more susceptible to injury. Teitz finds that of all the specific events that caused back pain, the most common is Outdoor Rowing. This finding, combined with the high correlation between back pain and longer ergometer workouts, supports the idea that ergometer training is not inherently dangerous in itself, but leaves the athlete under-prepared for rowing with conventional sweep handles. We believe that our pivoting oar handles help in preventing injuries because the load is evenly applied to a larger group of muscles through both shoulders, and the trunk is exposed to less torsion through the stroke.

For many teams, especially High School and Collegiate teams, reducing ergometer training time and substituting on-the-water training is not a realistic option. By using pivoting oar handles in practices and races, the training motion of the ergometer will be more compatible with the motion of rowing the boat on the water.