POTENTIATION OF SPINAL INJURY IN LIFTING

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Lumbar disorders are amongst the major causes of absenteeism in industry. The pain and misery endured, the financial considerations of man hours lost and the understandable difficulty to diagnose and cure the problems make prevention a worthwhile study. Prevention is impossible without understanding the circumstances potentiating injury.

Bradford and Spurling in 1945 calculated that pressures in the region of 1,600 lb/sq. ins. occur in the lower part of the spine during straight legged lifting. This calculation viewed the body mechanically rather than biomechanically. There is in fact a postural reaction to the load of swaying backwards, and an unavoidable increase in intra-truncal pressure. The later work by Floyd and Silver, 1955, showed erectores spinae to be electromyographically silent in the early phase of loaded extension. Whilst this is true the contribution of these muscles to this movement is also a function of the weight lifted, the time taken and the extent of flexion considered relative to the mobility of the individual. The work led to even greater concern about the dangers to which the spinal column is subjected in this movement.

This communication is an attempt to demonstrate the techniques we have used to investigate the activity of the erectores spinae (sacrospinalis) muscles relative to the changing mechanical advantages in which their contraction is exerted during spinal extension under the stress of a load. We hope that it may give some indication of how inadequate adaptation of body posture to heavy manual work may be the precursor of spinal stress, degeneration, weakness and resultant injury.

The information on changing spinal configuration and the muscular activity evident at any one point in the movement has been obtained by synchronised electromyographic and cinematographic techniques. The mathematical analysis of the data permits a comprehensive investigation of body mechanics in stress conditions.

The provision of reference points on film and EMG trace have made it possible to isolate the exact cine film frame at which onset and decline of the major levels of contractile activity occur. The shapes of the spinal column at these and other points have been derived from the film with the aid of suction pointers attached over the spinous processes. The nature of the component parts of the spinal curvature have been analysed by computer techniques.

In conclusion the investigation showed:

1. What may be termed as a momentary shortening of the arm of force from the lumbosacral junction to the centre of weight of the upper body and load, i.e. further flexion formed the initial movement of extension.
2. A shift in the point of maximum spinal curvature during the early phase of the lift and of extension, from the region of T.11 to that of L.2. (See Fig.1) The point of stress that would potentiate injury can be seen to move with the point of maximum curvature and therefore weakness of the spinal column. (There are relatively few accurate case histories of injuries actually caused during lifting, but there

appears to be close correlation with the sites of such injuries and the area through which maximum spinal curvature moves during the critical phase).

3. That if the lumbosacral joint is considered fixed relative to the rest of the spine, i.e. acting as a fulcrum of spinal movement, the calculated mean curves for the spinal configurations derived for each of 15 subjects by the computer analysis passed through or very close to the point representing T.6. This is illustrated in Figure 2. During extension this point remains equidistant from the sacrum and is therefore fixed in space relative to it. T.6. may therefore be considered as another fulcrum of spinal movement. Extension occurring between T.6 and the lumbosacral junction must by definition be greatest at the thoraco-lumbar junction.

Since extreme forces involved in stoop lifting must operate at this weak link, injury is potentiated. It would seem logical to suggest that any attempt to lift heavy loads should be stopped immediately if the hips cannot be kept below the level of the upper body as the legs extend.

Injury with or without pain, by other means, may in fact be diagnostic of the weakness resulting from the continual stresses of adopting inappropriate lifting techniques. It is the responsibility of the remedial gymnast to appreciate the causes of injury. It may be that the form of rehabilitation treatment should differ for injuries caused by direct lesions to healthy spines, and for injuries which may be the result of increased weakness caused by such lifting as we have considered.

- References** Bradford, F.K. and Spurling, R.G. (1945): "The Intervertebral Disc". Springfield, Illinois: Charles C. Thomas.
- Floyd, W.F. and Silver, P.H.S. (1955): "The function of the erector spinae muscles in certain movements and postures in man". J.Physiol., 139, 184-203.

Fig. 1.

Fig. 3 MEAN CONFIGURATIONS WITH RESPECT TO MEAN BACK SLOPES AT POINTS OF INTEREST

Position of electrodes, and rods marking vertebrae C7, T6, T12, L3, S2.

Fig. 4.

Fig. 5.