

AN INTERVERTEBRAL JOINT'S CENTRE OF ROTATION AFFECTS THE FORCES EXPERIENCED BY THE ZYGAPOPHYSIAL JOINTS.

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INTRODUCTION

Modifying the mechanics of an intervertebral joint through, e.g., discectomy or implantation of an artificial disc will cause changes to the forces components of the joint experience during normal activities. This study examined how the forces on the zygapophysial joints are affected by changes in the position of the intervertebral joint's centre of rotation in order to assess the potential for accelerated degeneration to occur (Pearcy, 2010).

METHODS

Polymer models of the L4 and L5 vertebrae from the 'Visible Human Project®' data set were made ensuring fidelity of the shape of the zygapophysial processes. These were then mounted in a robotic testing machine (de Visser et al., 2007) and aligned to represent the functional L4/5 intervertebral joint. The superior vertebra was rotated axially $\pm 3.5^\circ$ with the axis of rotation set at 60% of the depth of the disc. The forces caused by contact between the faces of the zygapophysial processes were measured. The test was then repeated with the axis of rotation moved 4mm anteriorly then posteriorly, and then 4mm anteriorly plus 4mm to the left and then to the right.

RESULTS

The maxima of the resultant forces experienced by the L5 vertebra.

| Position of axis | Force Twist to L / N | Force Twist to R / N | % Diff from Central position of axis | |
|------------------------|----------------------|----------------------|--------------------------------------|-----------|
| Central | 45.1 | 66.6 | | |
| Anterior 4mm | 50.1 | 80.5 | 11 | 21 |
| Posterior 4mm | 42.5 | 66.1 | -6 | -1 |
| Central | 43.7 | 42.4 | | |
| Anterior and Left 4mm | 52.6 | 51.6 | 20 | 22 |
| Anterior and Right 4mm | 42.6 | 55.5 | -3 | 31 |

CONCLUSION

The % difference shows that moving the centre of rotation 4mm can cause an increase in the force experienced by the zygapophysial joints of up to 31%. As this is a purely geometric phenomenon the displacement of the centre by 1mm would cause an increase of nearly 8%. Repeated exposure to this increased loading might be expected to lead to early degenerative changes. The data also show that small asymmetries in the joints cause significant changes to the forces experienced. Because of geometric differences some individuals will be more susceptible to degeneration caused by changes to the centre of rotation of the intervertebral joint if it is altered by surgery.

REFERENCES

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