WHY DO VERTEBRAL FRACTURES USUALLY AFFECT THE CRANIAL ENDPLATE?
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Introduction
Endplate fractures are clinically important. They are very common, are associated with an increased risk of back pain, and can probably lead on to intervertebral disc degeneration (1,2). For reasons that are poorly understood, high compressive loading of the spine in vivo and ex vivo tends to damage the cranial endplate much more often than the caudal. Trabecular arcades are not symmetrical in thoracolumbar vertebrae, and the pedicles lie closer to the cranial endplate than to the caudal. We hypothesise that the vulnerability of cranial endplates arises from an underlying structural asymmetry in cortical and cancellous bone.

Materials and methods
47 “motion segments”, consisting of two vertebras and the intervening disc and ligaments, were obtained from human spines aged 62-90 yrs. All levels between T10-11 and L4-5 were represented. Each motion segment was secured in cups of plaster, positioned in 4-6° of flexion, and compressed to failure at 1mm/s. Damage was assessed from radiographs in the sagittal and frontal planes, and at subsequent dissection. Two 2mm-thick slices were obtained from each vertebral body in the sagittal plane (Figure 1). Microradiographs were obtained for each intact slice (n = 181).

Image analysis software (ImageJ, NIH) yielded the following information: cortical thickness and image greyscale density (IGD) at 10 locations on each of the cranial and caudal cortices. In addition IGD was measured of the cancellous bone in 3 regions (anterior, middle and posterior) adjacent to each endplate in 57 vertebral slices. Preliminary tests showed IGD was highly correlated to BMD measured by DXA (R² = 0.96, P<0.001). Results for 28 mid-sagittal slices are on the left; for 29 lateral slices on the right. Numbers are percentage opacity (0 = completely radiolucent, 100 = totally radio-opaque) and are presented as mean (SEM). Green stars indicate significant differences between corresponding cranial and caudal regions. Cranial regions tended to have a lower cancellous bone density than corresponding caudal regions, especially posteriorly.

Discussion
Our hypothesis is supported: in elderly human thoracolumbar spines, cranial endplates are more vulnerable to compressive overload because they are thinner and are supported by less dense cancellous bone.

Other considerations, but remain relatively thin, possibly in response to nutritional and mechanical influences may interact. The thick L4-S1 discs have the most precarious nutrient supply, and yet their endplates do not thicken as might be expected from mechanical considerations, but remain relatively thin, possibly in response to nutritional demands. This makes them vulnerable to fracture.

References

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