LETTER TO THE EDITOR

All osteoporotically deformed vertebrae with > 34% height loss have radiographically identifiable endplate/ cortex fracture

Vertebral fractures (VFs) are the most common osteoporotic fracture. A VF, after minor trauma, is a hallmark of osteoporosis. Prevalent VFs increase the risk of future vertebral and nonvertebral osteoporotic fracture independent of bone mineral density (BMD). VFs are associated with poor life quality, impaired bending and rising, difficulties in the activities of daily living, frailty, higher risk of hospitalisation and higher mortality. It is important to identify and report VFs. Appropriate management of osteoporosis can reduce future fracture risk. However, currently there is still a lack of clear diagnostic criteria of VF [1]. Genant's semiquantitative (SQ) method is commonly used with the following criteria: grade 1, 20—25% reduction in anterior, middle or posterior height and 10—20% reduction in area; grade 2, approximately 25—40% reduction in any height and 20—40% reduction in area and grade 3, ≥40% reduction in any height and area [2]. In addition, the vertebral shape is evaluated to exclude deformities such as developmental short vertebral height, Cupid's bow deformity, Scheuermann's disease and Schmorl's nodes and degenerative remodelling. The SQ method, as described initially, does not require a radiological fracture sign as the precondition. It is understood that at least some grade-1 SQ vertebral deformity (VD) may not be true fracture. To overcome this problem, the algorithm-based qualitative (ABQ) approach assumes that the endplate is always deformed in VFs and is 100% sensitive [3,4].

A number of articles have been published very recently, including ours, specifically looked for endplate and other vertebral cortex facture sign [5—8]. The results are generally in favour of ABQ approach and its variants. For example, Lentle et al. showed that ABQ grade-1 VF was associated with higher risk of vertebral fracture as well as nonvertebral major osteoporotic fracture, while grade-1 SQ-VD deformity was not associated higher nonvertebral fracture [5]. We showed patients with grade-1 SQ-VD had a similar BMD compared with patients without fracture, while patients with grade-1 ABQ VF had lower BMD [8]. Compared with VD-based methods, all studies show a much lower VF prevalence using ABQ approach [5,6,8].

The modified ABQ method used by Lentle et al. [5] was similar to our approach of assessing vertebral endplate/ cortex facture (ECF). VD was evaluated according to Genant's criteria [5,8]. In addition to endplate, any vertebral cortex fracture was evaluated. For example, vertebra compress and crush may lead to fracture of the anterior cortex but may not necessarily have endplate involvement [5,7,9]. Our results show that, at per vertebral level, 84.3% of grade-1 SQ-VDs in men were ECF(−), and 65.5% of grade-1 SQ-VDs in women were ECF(−). 38.6% of grade-2 SQ-VDs in men were ECF(−), and 40.8% of grade-2 SQ-VDs in women were ECF(−). Grade-3 SQ-VDs were all ECF(+), both for men and for women (percentage derived from table- 6 in reference 8). Broadly these results agree with the study by Lentle et al. [5]; they also showed, with men and women combined, 35.3% grade-2 SQ-VDs did not have vertebral ECF. Though Jiang et al. [3] suggested endplate is always deformed in osteoporotic VFs, we agree with Szulc that radiographic ECF cannot always be confidently identified for some cases with true VF [1], and this is partially because of the spatial resolution limitation of radiograph [9]. If we assume that we can identify the vast majority of ECF (if not all), then it is confusing that approximately 40% of grade-2 SQ-VDs were ECF (−). We therefore hypothesise that grade-2 SQ-VDs can be subdivided, with "severe" grade-2 SQ-VDs mostly being ECF(+). To this end, using the data of our published work [8], we made a plot of percentage height loss vs ECF (±) for grade-2 SQ-VDs. The results are shown as below:

Figures 1A and 1B show, for both women and men, 34% height loss offer a threshold to separate ECF (+) vertebrae from ECF(−) vertebrae, i.e. those of >34% height loss are always true VF with radiographical fracture sign. More interestingly, in men, those vertebrae with less than 34% height loss tended to be ECF(−). On the other hand, a threshold of 30% height reduction does not seem to offer
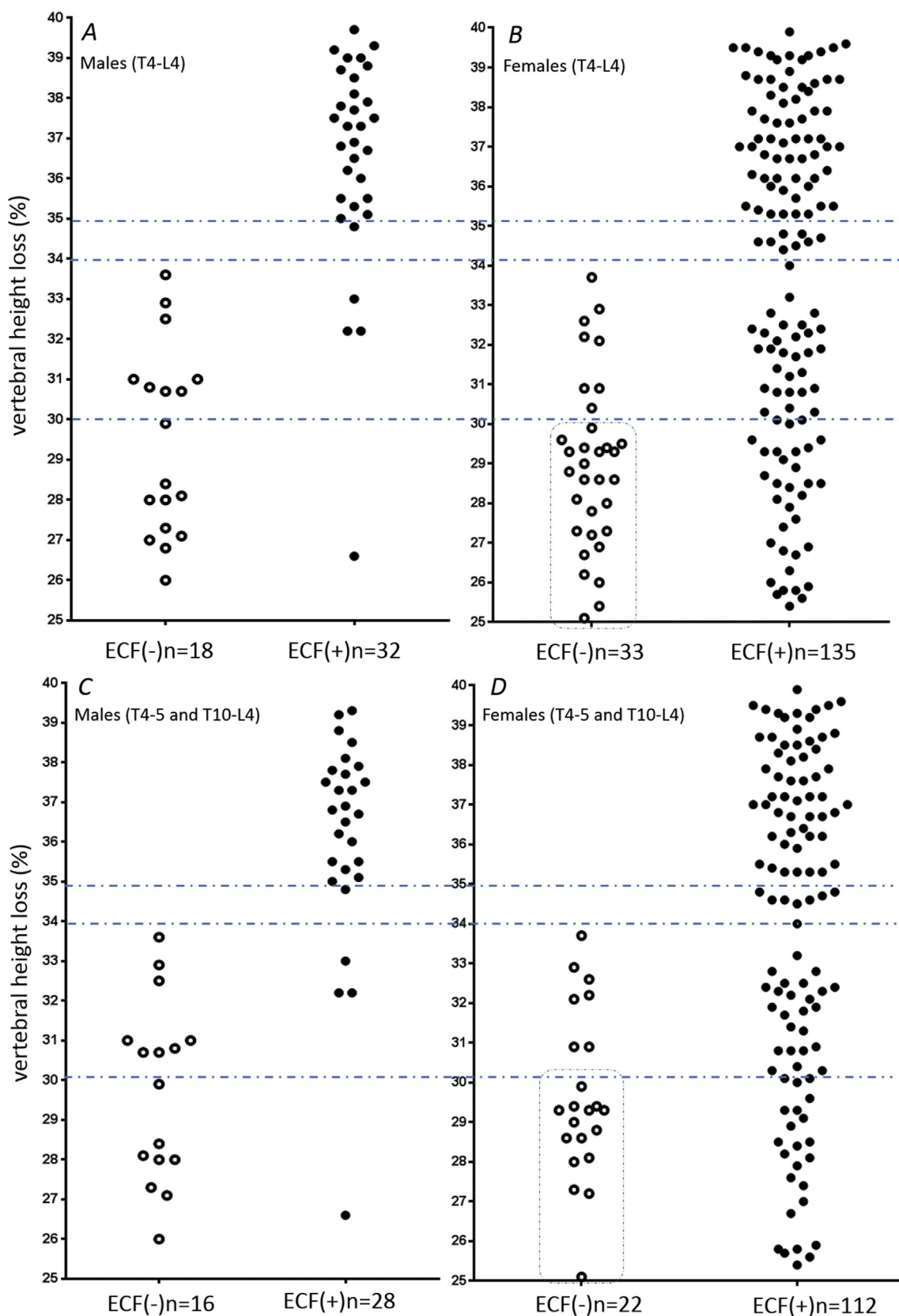
Figure 1   Scattered plot of percentage vertebral height loss vs. endplate/cortex fracture (ECF) at individual vertebra level for grade-2 VDs from MsOS (Hong Kong) and MrOs (Hong Kong) baseline studies [8]. (A—B) T4-L4 vertebrae; (C—D) T4-5 and T10-L4 vertebrae (T6-T9 excluded). Note in the study the vertebral height loss was measured rather than estimated [8].

separation of vertebrae with or without ECF. Figure 1 shows in females, vertebrae with 30—34% height reduction were less likely to be ECF(−) than those with 25—30% height reduction (18.4% vs. 44.6%, i.e. female vertebrae with 30—34% height reduction would be ECF(+) with an approximate 4/5 probability, while female vertebrae with 25—30% height reduction would be ECF(+) with an approximate $^1/_2$ probability). We have already shown that for grade-2 SQ-VDs, patients were ECF(+) and had lower spine BMD and hip BMD than those were ECF(−), both for men and for women [8].

Szulc et al. [10] suggested that T6-T9 vertebrae are more likely to be wedge shaped, particularly for males. We tested to take off VD grade-2 T6-T9 vertebrae in Figures 1A and 1B, and the result is shown in Figures 1C and 1D. It shows that in females, the proportion of ECF(−) with 25—34% height reduction indeed decreases after the removal of T6-T9 vertebrae. However, at least in our data, the ECF(−) grade-2 VDs were not predominantly caused by wedge-shaped T6-T9 vertebrae.

There are two notable features in our results [8]. One is that the proportion of middle thoracic vertebrae VD was quite low for both men and women compared with some other reports [2,3,5,6]. Additionally, in our study, the total VD prevalence (inclusive of grade-1 VD) was lower in men (13.20%, mean age: 72.3 years) than in women (16.08%, mean age: 72.5 years); while some other reported higher total VD prevalence in men than in women [11]. We expect this is because all the radiographs in our study were carefully double-read by two experienced radiologists. While we cannot claim that our results should be correct, this at least raise the possibility that some of the VD/VF in middle thoracic region in previously reported studies may be due to false positive reading [1].

Of note, microscopic fractures as shown by histology are common in radiographically normal vertebrae [12,13]. Certainly some SQ-VD vertebrae with ECF(−) have true osteoporotic fracture, which in our experience, usually demonstrate "nongradual" or "sudden" morphological deformities when compared with adjacent vertebrae. In a longitudinal study, Lentle et al. [5] reported that patients with prevalent grade-1 SQ-VD were associated with incident SQ-VD compared with those without prevalent SQ-VD [5]. The importance of ECF (−) grade-1 SQ-VD in predicting future osteoporotic fracture remains to be further investigated.

In conclusion, our result suggests that grade-2 SQ-VD with height loss >34% may constitute a subcategory and always reflect true VF, or maybe severe grade-2 SQ-VD can be grouped into grade-3 SQ-VD.

Conflict of interest

The authors have no conflicts of interest to declare.

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