Letter to the Editor

On the possibility of over-diagnosis of osteoporotic vertebral fracture at mid-thoracic level

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Osteoporotic vertebral fracture (OVF) is the most common osteoporotic fracture. Prevalent OVFs increase the risk of future vertebral and non-vertebral osteoporotic fracture independent of bone mineral density (BMD) (1-4). OVFs are associated with poor life quality, impaired bending and rising, difficulties in the activities of daily living, frailty, higher risk of hospitalization, and higher mortality (4-8). Appropriate interventions for VF can reduce the occurrence of hip fractures, preventing further OVF, reducing pain and related disabilities (1,9-11). It is important to identify and report OVF, so that appropriate investigation and treatment can be instigated.

However, the diagnosis of OVF has no golden standard, particularly for the minimal or mild grade OVF, reader's subjectivity plays a role (12-17). Genant's SQ (semi-quantitative) method has been the most commonly used criteria (18,19). Recent reports emphasize the importance of identifying osteoporotic endplate/cortex fracture (ECF) (also called ABQ fracture) (20-27). Recently, Wang emphasized the importance of identifying OVF with less than 20% vertebral body height loss, which would be equivalent to Genant's SQ 0.5 grade (13,14). Wang *et al.* also attempted to classify Genant's SQ grade-2 OVF into two sub-grades, those with 25–34% height loss and those with 34–40% height loss (26,27). It was noted that OVFs with vertebral height loss >34% are always associated with ECF (26-28).

In this letter, we argue that, according to the many published data, there is a high possibility that OVF at mid-thoracic level (T7-T9) has been over-diagnosed in many cases. This has been noted in one our letter (28). Compared with some other literature reports, the proportion of mid-thoracic OVF was relatively low for both men and women in our studies (29) (*Figure 1*). Hereby we put forward another argument for this point. Recently, we analyzed traumatic endplate fracture (EPF) in 118 males and 76 females patients (mean: 42.11±9.82 years; range: 13–55 years). The causes of the trauma included 69.1% with traffic accident, 16.5% with fall from >2 meters height; the rest were caused by sports injury and heavy subject contusion. There were a total of 263 VFs, with 191 EPFs confirmed by CT, 52 EPFs confirmed by MRI, and 20 EPFs confirmed by X-ray. The imaging diagnosis of traumatic EPF were considered to be highly reliable for these cases. The vertebra-distribution of these EPF cases well agrees with other authors' reports on traumatic VFs [such as figure 4 of reference (30)]. We have recently published the vertebra-level distribution of osteoporotic ECF in elderly subjects (29,31). It should be noted that the majorities of vertebral ECFs are EPF, or EPF and anterior cortex fracture coexist (24). We made plots to overlay the traumatic EPF and osteoporotic ECF's vertebra-level distribution (*Figure 2*). As it can be seen, the vertebra-level distribution of traumatic EPF and osteoporotic ECF's match each other. This may have two implications. One confirms that both thoracolumbar junction and middle thoracic spine are physiological weak points for biomechanical stress, causing both traumatic VF and OVF to more likely occur in these sites. The second point is that, for both traumatic VF and OVF, the

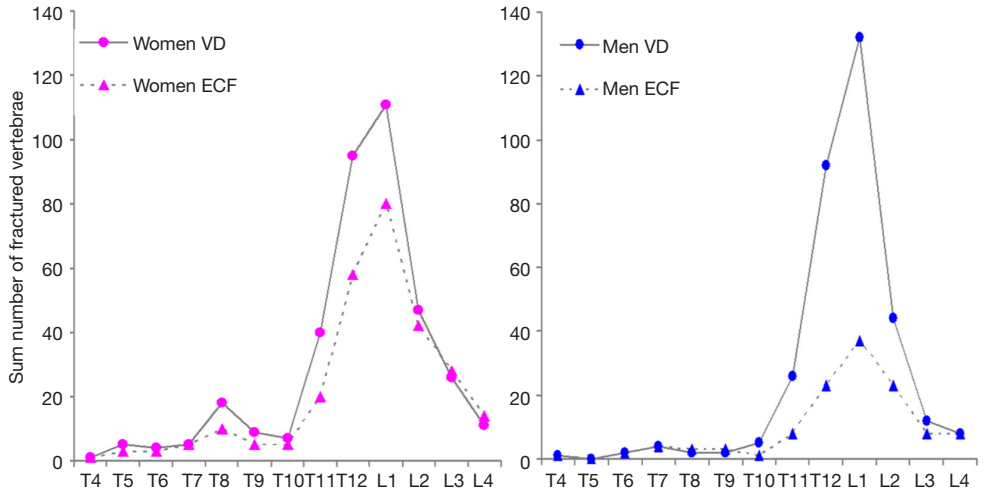

Figure 1 Osteoporotic vertebral deformity (VD) and endplate/cortex fracture (ECF) vertebra-distribution from MrOS (Hong Kong) and MsOS (Hong Kong) baseline studies, involving 1,954 elderly Chinese men (mean: 72.3 years) and 1,953 elderly Chinese women (mean: 72.5 years). Reproduced from (29) with permission.

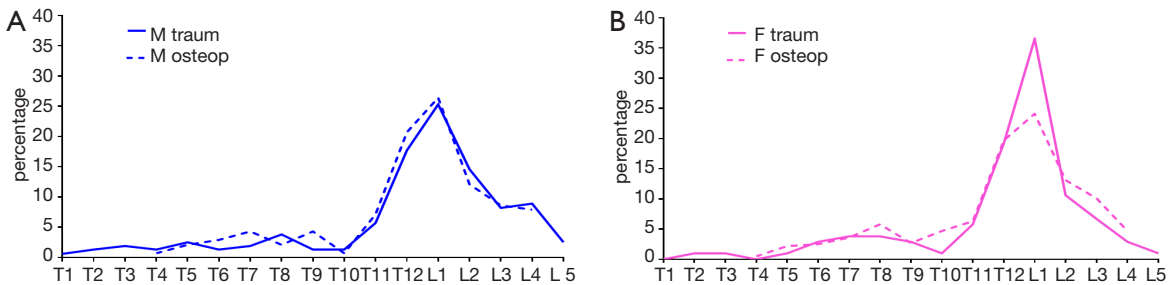

Figure 2 Percentage distribution of traumatic EPF (n=118 for males, and n=76 for females, mean age: 42.11±9.82) and osteoporotic ECF (1,954 males, mean age: 72.3 years, range, 65–92 years; 1,953 females, mean age: 72.5 years, range, 65–98 years) at each vertebral levels. (A) For male subjects and (B) for female subjects. For traumatic EPF, all T1-L5 were counted; while for osteoporotic ECF, only T4-L4 were counted. The data of osteoporotic ECF were from (31), reproduced with permission. Similar vertebra level distributions are noted for traumatic EPF and osteoporotic ECF. Majority of traumatic EPF and osteoporotic ECF occurred among T11-L4, with only a small prevalence peak at mid-thoracic level, both for males and females.

frequency at mid-thoracic location is much lesser than thoracolumbar junction [also see figure 4 of reference (30)]. Actually, the majority of OVFs occur among T11-L4 (*Figures 1,2*). We acknowledge that not all OVFs have visible ECF on radiograph, but ECF is a more specific sign of fracture as compared with mere vertebral deformity which can have many causes such as physiological ageing and degenerative osteoarthritis, in addition to being osteoporotic. If we take assumption that OVFs with both visible and invisible ECF, i.e., all OVFs inclusive, are in proportion to OVFs with visible ECF, then unless there is further evidence that thoracic OVFs are more likely to be associated with invisible ECF or are truly with no ECF (as compared with those in thoracolumbar junction and in lumbar spine), the evidences presented in this letter suggest that prevalence OVF at middle thoracic level would be much less in proportion than those at thoracolumbar junction and in lumbar spine.

Another point should be noted is that males' vertebrae are physiologically more wedge-shaped than those of females (32,33). Moreover, the clinical relevance of OVF in males may be much lower (34-36). Recently we

demonstrated that, compared with age-matched elderly females, elderly males at their early seventies have lower risk of short-term (4-year period) VF progression/new incident VF. Even for those with existing VF at baseline, elderly males are associated with much less further risk of VF progression/new VF as compared with elderly females (27). Before suggesting a VF to be osteoporotic in male patients encountered in clinical practice, in addition to considering the possibility of physiological wedging, degenerative wedging and other congenital causes (37), secondary causes such as old trauma, metabolic diseases, and oncologic conditions, should be ruled out.

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Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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