When all the issues are considered, there can be a third option. Routine ultrasound examination for fetal abnormalities is practised in most centres that do invasive prenatal tests. When an invasive test is indicated on the basis of an increased risk of Down's syndrome (from various Down's screening tests or advanced maternal age) without fetal abnormalities, FISH or PCR for chromosomes 21, 18, and 13 can be used as the stand-alone test. If ultrasound features are suggestive of fetal Turner's syndrome, FISH or PCR for chromosomes X and Y are added.[15] Karyotyping after FISH or PCR for chromosomes 21, 18, 13, X, and Y will be reserved only for those cases where fetal abnormalities are detected by ultrasound, to assess the whole spectrum of structural chromosomal abnormalities in addition to the common aneuploidies. Such an approach is being studied in our centre, and our results might provide a cost-effective solution to this dilemma.

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The biomechanics of hip fracture

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The exponential rise in hip-fracture risk with ageing is not fully explained by the corresponding fall in bone mineral density of the proximal femur. Instead, ageing affects hip-fracture risk independently of bone mineral density, suggesting that there are other important age-related changes that must be considered. Of course, falls are important. Elderly people are more likely to fall down;[1,2] therefore their risk of hip fracture should increase. In addition, ageing causes structural changes in the proximal femur that might increase the risk of fracture should someone fall on their side. Over a decade ago, Yoshikawa et al[3] showed that bone loss occurs preferentially on the superior aspect of the femoral neck. This region of the femoral neck is under minimum mechanical stress during walking, whereas a fall on the hip reverses the stress pattern causing high compressive stresses at the superior neck (figure). Consequently, with ageing, bone is lost in the specific location that is most highly stressed by a fall.

In this issue of *The Lancet*, Paul Mayhew and colleagues[4] propose that structural changes in the femoral neck, which might occur independently of osteoporosis, contribute greatly to the risk of hip fracture. They note that bone loss at the superior aspect of the femoral neck could make the bone susceptible to failure by buckling. Buckling is most commonly associated with slender columns. A column loaded in compression can bow laterally and, if the lateral displacement of the column surpasses a critical amount, the column will collapse. Buckling has long been proposed as a mechanism of failure for long slender bony trabeculae within osteoporotic vertebral bodies.[5] Mayhew and colleagues propose a different form of buckling in the femoral neck. They envision the thin cortical shell of the neck to be similar to an aluminum can. When you step on an aluminum can, the thin walls collapse under your weight. This failure mechanism, called shell buckling, is proposed to occur at the superior femoral neck due to large compressive stresses caused by a fall. Mayhew shows convincing evidence that cortical thinning occurs preferentially at the superior neck whereas the inferior cortical shell actually gains thickness with age. (The latter effect is thought to be an adaptive response to walking, which causes large compressive stresses on the inferior neck [figure].) If the femoral neck does indeed behave like a shell, the superior region should be at high risk of buckling during a sideways fall.

But is the femoral neck a shell? I am concerned that Mayhew and colleagues' shell-buckling theory might be overly simplistic. The femoral neck is filled with trabecular bone and marrow, making it a far more complex structure than an empty shell. The buttressing of the cortex by bony trabeculae reduces the probability of buckling and one cannot discount the mechanical role of marrow. For instance, an aluminum can filled with fluid is harder to crush than an empty one. In addition, shells fail in a "snap-buckling" mode, which causes a characteristic shape of the load-displacement curve (this curve is widely used by engineers to evaluate failure of materials or structures). Briefly, a shell will "snap" causing a negative stiffness and sudden reduction in load capacity immediately after a critical load is surpassed (snap-buckling was recently shown to be the mechanism by which the Venus flytrap captures its prey[6]). To my knowledge, nobody has reported any evidence of snap-buckling behaviour in the femoral neck, although numerous biomechanical tests have been done on cadaveric specimens. I do acknowledge that the snap phenomenon might occur in osteoporotic femoral necks but has simply eluded detection.

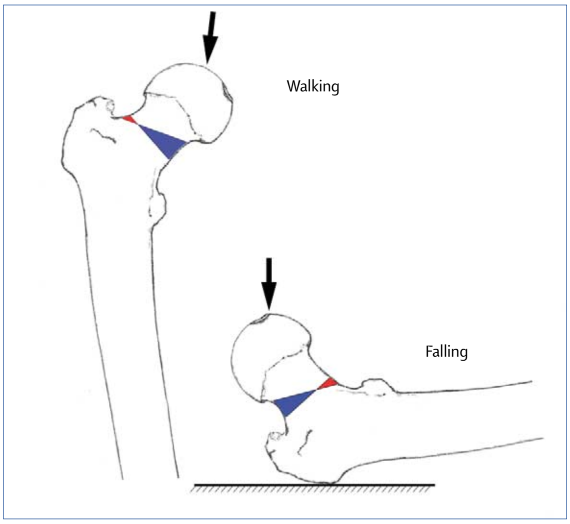

***Figure:* Mechanical stresses on femoral neck**
Peak mechanical stresses on femoral neck during walking include large amount of compression (blue) at inferior surface with small tension (red) at superior surface. Force of fall on hip reverses stresses on femoral neck, causing large amount of compression on superior neck and tension on inferior neck.

Whilst the concept of buckling failure in the femoral neck is not entirely supported by experimental data, it remains a viable theory. Certainly the rapid age-related loss of bone structure at the superior femoral neck should increase hip-fracture risk. Mayhew and colleagues provide a compelling argument for more diligent assessment of the regional patterns of bone loss in the femoral neck and point to the need for targeted interventions that strengthen bone at the superior neck.

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I have served as a consultant for Schering Plough, Amylin Pharmaceuticals, Amgen, and ClinTrials BioResearch, and have received honoraria for lectures from Eli Lilly and Merck.

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