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The last 10 years has seen great advances in our ability to understand bone physiology and, as a result, to treat osteoporosis. This ability promises to increase even further over the remaining years of the Bone and Joint Decade. The definition of osteoporosis has recently changed from focusing on bone density to concentrating more on bone strength, currently more difficult to measure. Bone size, bone geometry, bone microarchitecture, and bone turnover, as well as bone density, all also contribute to bone strength. In the future, non-invasive measurement of bone microarchitecture and bone strength by micro pQCT and micro MRI will refine the diagnosis and monitoring of treatment of osteoporosis. However, bone density measured by dual energy x-ray absorptiometry at axial skeletal sites remains the best tool today. Epidemiological studies in the future will refine the assessment of absolute risk for osteoporotic fracture in the individual patient. At both a global and national public health level, optimising calcium and vitamin D nutrition is likely to be an important way whereby the impact of osteoporosis may be lessened. Low-cost vitamin D supplements are required. Falls prevention in the elderly is another important public health approach.

At the level of the bone-remodelling unit, important signalling systems have been identified linking osteoblasts, or bone forming cells with osteoclasts, or bone resorbing cells. RANK ligand (RANK L) is expressed by osteoblasts and acts on RANK on osteoclasts and osteoclast precursor cells to increase osteoclast formation and differentiation, and to decrease apoptosis. A decoy receptor for RANK L, osteoprotegerin or OPG, has been shown to be a potent inhibitor of bone resorption. Antibodies directed against RANK-L also inhibit bone resorption for as long as nine months after a single dose and may be a treatment for osteoporosis in the future.

Although oestrogen has fallen from favour as a treatment for osteoporosis because of concerns about its long-term safety when combined with progestagens, other antiresorptive agents have been shown to prevent fractures in osteoporosis. A selective oestrogen receptor modulator, raloxifene, and the bisphosphonates, alendronate and risedronate, all reduce fractures in postmenopausal women with osteoporosis. These drugs inhibit bone resorption and prevent bone loss, but because bone formation and mineralisation continue they cause modest increases in bone density. By contrast, intermittent administration of human PTH(1-34) or teriparatide has been shown to directly stimulate bone formation and its use increases bone strength independently of increases in bone density and has the potential to actually reverse osteoporosis. Its use also increases bone size, another mechanism whereby bone strength is enhanced. Teriparatide is likely to represent the first of a new era of potent anabolic treatments for osteoporosis,

Genetics has contributed to our understanding of the cellular processes controlling bone formation. Activating or inactivating mutations in an unanticipated gene, lipoprotein receptor-related protein 5 (LRP5), may result in either familial high bone density or the osteoporosis pseudoglioma syndrome, respectively. The downstream Wnt signalling pathway from this receptor is important in regulating bone formation and may have a role in the anabolic actions of PTH on bone. It will also be a target for novel anabolic drugs in the future. Identification of genetic polymorphisms associated with osteoporosis is continuing with the majority of the genetic variance in bone density remaining unexplained. It is possible the best use of these polymorphisms will be in determining individual responses to anti-osteoporotic drugs (pharmacogenetics).

In conclusion, The Bone and Joint Decade holds great promise in bringing people together to reduce the global burden of fractures due to osteoporosis.