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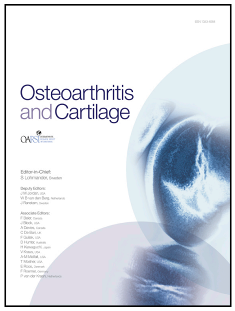

Subchondral bone — a welcome distraction in OA treatment

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Editorial

Subchondral bone — a welcome distraction in OA treatment

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Of the 291 conditions studied by the Global Burden of Disease study in 2010, hip and knee osteoarthritis (OA) together ranked as the 11th highest contributor to global disability (as measured by years lost to disability)[1]. Despite how common it is, how many are affected, and the history of the disease, therapeutic interventions are limited. The earliest descriptions distinguishing OA from rheumatoid arthritis and gout depicted it as a whole-joint disorder associated with inflammation[2,3]. In the last half of the twentieth century, however, OA became characterized as a cartilage disorder attributed to 'wear and tear'. Accordingly, during this time, nearly all the research focused on cartilage. While it is fair to say that we now understand far better the complexities and subtleties of this remarkable tissue — its physiology, structure, and function — back then we were no closer to finding a cure for OA. Indeed, by far the most momentous advance in treatment was low-friction arthroplasty, pioneered by John Charnley, in which the whole joint is effectively removed. More recently, it has been proposed that we should consider the joint as an organ[4,5]; in this sense, we have come full circle.

Understanding the interplay between cartilage and the underlying bone that supports it is fundamental to understanding the joint. We then need to add innervation, vascularization, and the other tissues intimately involved, including adipose, fibrous capsule, and synovium. This makes 'the joint' at least as complex as any other organ in the body, and one that is frequently underestimated and undervalued. And, of course, every joint is slightly different. So, what is going on in the bone in OA?

Studies in patients with hip OA have identified an increased bone mineral density not only in the hip but also in the distal radius, vertebrae, and calcaneus[6]. Scintigraphy has shown increased bone formation in OA joints[7]. Laboratory studies have found alterations in the bone matrix and in osteoblast behaviour. In the hip, we found an increase in cancellous bone volume of about 60%, but this was associated with a reduced mineralization[8]. In addition, although the subchondral bone plate was thicker, it too was less well mineralized[9].

Osteophytes are outgrowths of bone and cartilage found in many patients at the margins of diarthrodial joints or as outgrowths in the central portions of the articular space[10]. They form by endochondral ossification[11]. Together, these and other observations have led to the suggestion that OA is a dysregulated growth process rather than one of degeneration[3]. These changes in bone metabolism also lead to changes in the morphology of the joint. They can be quantified in 2D and 3D using statistical shape modelling[12, 13], and work is in progress to use these measures in disease monitoring[14].

Have there been any advances in therapeutic approaches to the whole joint? In this issue of Osteoarthritis and Cartilage, Jansen et al. report on the changes occurring in subchondral bone over a period of 2 years from undergoing distraction of the knee joint for OA. Distraction, using an external fixation frame, separates the tibia and femur by 5 mm over a period of 4 days and holds the joint in that position for 6 weeks. The authors have previously presented evidence that in young patients (under 65 years of age) with tibiofemoral OA, 6 weeks of joint distraction results in an increase in cartilage thickness that is still evident at 10 years, albeit somewhat reduced from the initial distracted thickness[15].

Baseline assessment of the bone, using CT, suggested that the subchondral bone plate was thickened in the most-affected compartment (MAC), and that the subchondral bone density was increased compared with the least-affected compartment (LAC). One year after distraction therapy, the authors found that the subchondral bone in the MAC had thinned and become less dense. After a further year, these properties were more-or-less unchanged.

Distraction will result in unloading of the [i]joint. It is well established that bone responds positively to mechanical loading and that unloading leads to gradual bone loss. In that regard, the changes seen are in the expected direction. Given that neither joint morphology nor knee alignment appear to have been altered, it seems quite dramatic that 6 weeks of unloading, followed by 12 months of reloading, can result in such long-term changes. Could it be that the increased thickness of cartilage in the MAC is sufficient to realign the joint just enough to relieve the biomechanical stresses? Or is 5 mm of leg lengthening enough to induce small alterations in gait that have long-term effects? In addition, distracting the joint could stretch the capsule and thus affect its metabolism. The authors point out that other studies have found anabolic and catabolic changes resulting from joint distraction. These may indicate a modification of the whole-joint metabolism, including not only cartilage and bone but also synovial tissue activity that could lead to long-term joint repair[16].

Could this approach to treating the whole joint be taken up more widely and used in older patients? The surgery is not complicated, although avoiding infection tracking through the pins will be important. The cost should be far less than a total knee replacement, and rehabilitation is almost immediate — patients are sent home and told to weight bear until the fixator is removed. The results presented in this journal provide further evidence for sustained and beneficial changes in the joint, and suggest that this approach is worthy of serious consideration.

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