Bone & Joint

Focus On

Applications of bone graft substitutes in sports medicine

Bone graft substitutes are now commonly used in orthopaedic surgery as an alternative to autogenous bone graft. This short review will focus on applications of bone graft substitutes in sports medicine, trauma and spine surgery.

Sports medicine

There is a relative paucity of literature supporting the use of bone graft substitutes in sports medicine compared with trauma or spinal surgery. One of the most common bone grafting indications in sports medicine is opening wedge tibial osteotomy. When compared alongside autogenous iliac crest bone graft (AICBG), union of tibial osteotomy took longer and pain persisted longer when ceramic wedges were used. At six months postoperatively, there was no difference between the two groups in terms of union and outcome. Recently, the use of bone grafting in osteotomy has been questioned in a study that showed no difference in complications, union time and rate in grafted and non-grafted osteotomies. It is currently unclear whether there is a need to graft the osteotomy site for corrections of < 10°. The existing evidence in the literature does not report any advantages of using synthetic wedges in this setting.

Osteochondral defect is another potential application for bone graft substitutes. The TruFit plug (Smith & Nephew), a biphasic polymer scaffold, has been studied as a donor site filler in mosaicplasty. The author showed good integration of the TruFit plug with mean MRI T1 relaxation times approaching those of normal articular cartilage. The same implant was tested in knee cartilage repair. The short-term clinical and radiological outcomes were considered modest, but it has been shown that the grafts tend to mature with time, suggesting that a longer follow-up period is needed before any conclusions can be drawn.

Other applications for bone graft substitutes in sports medicine include anterior cruciate ligament (ACL) autograft donor sites, graft tunnel expansion in ACL revision surgery and glenoid and humeral head defect in shoulder instability. There is, however, no evidence to support their use in the literature.

Trauma surgery

Bone defect is common after orthopaedic trauma, and bone graft substitutes are frequently used in this setting to fill metaphyseal voids. Calcium phosphate has been extensively studied in metaphyseal defects. The injection of calcium phosphate following closed reduction and cast immobilisation of distal radius fracture led to higher patient satisfaction and lower malunion incidence than cast immobilisation alone. In tibial plateau and distal radius fractures, injections of calcium phosphate improved the maintenance of articular surface reduction compared with autograft. Its use also allowed early weight-bearing without loss of articular surface reduction in calcaneum and tibial plateau fractures, and improved post-operative proximal femoral fracture stability. Finally, a recent meta-analysis confirmed that calcium phosphate cement decreased pain, maintained fracture reduction and improved functional outcomes when used in fracture treatment.

Recombinant human bone morphogenetic protein (rhBMP) is reported to be useful in fracture management, decreasing healing time and union rate. Biological and systemic factors are also available to improve fracture healing. Most of these factors have insufficient data in preclinical trials to determine efficacy, but platelet-derived growth factor and parathyroid hormone appear promising.

Spinal surgery

Common applications of bone graft substitutes in spinal surgery include vertebral fusion and fractured vertebral body. The efficacy of injection of polymethylmethacrylate cement (PMMA) into a vertebral body fracture has recently been questioned. Calcium phosphate and calcium sulfate cement are currently studied as alternative to PMMA, but there is not enough evidence to support their use.

In posterolateral spine fusion procedures, bone graft substitutes have been shown to reduce pain and blood loss when compared with autogenous iliac crest bone graft, although neither of these studies describe a rate of fusion. On the other hand, rhBMP has been widely studied in lumbar vertebral fusion procedures. Prospective randomised trials report better outcomes (fusion rate, blood loss, operative time, reoperation rate) with the use of rhBMP-2 compared with autogenous iliac crest graft. Safety remains a concern, however, with the use of rhBMP in spinal surgery with reports describing complication rates between 10% and 50% depending on the approach (ectopic bone formation in and around the spinal canal, post-operative radiculitis, vertebral osteolysis and allergic/hyperinflammatory response).

Platelet gels, demineralized bone matrix and bone grafts substitute have promising preclinical data but lack sufficient clinical data demonstrating efficacy in lumbar fusion.

P. Lavigne MD, PhD, FRCSC
Maisonneuve Rosemont Hospital
5345 #320 Assomption Boulevard
Montreal, Quebec
H1T 4B3, Canada
E-mail: lavignepatrick@videotron.ca

This article was originally published in the Canadian Orthopaedic Association’s COA Bulletin #95, Winter 2011 edition.
References