ROUNDUP360

Research

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Orthopaedics: a dangerous profession?

■ It is often said that orthopaedic surgeons are just glamorous carpenters. The parallels are obvious, a physically demanding specialty, often sharing and relying on skills learned over the centuries by carpenters and joiners (take the humble Scarf osteotomy, for example). However, although much is written about and known about occupational injuries in other physically demanding jobs, there is surprisingly little known about occupational injuries in orthopaedics as a surgical specialty. Even less is known about the impact of these injuries on the healthcare economy. A research team in **Nashville (USA)** have performed what is probably the only investigation into this potential problem. The research team designed a self-completed survey aimed to assess occupational injury among orthopaedic surgeons. The survey was administered to all orthopaedic surgeons in the state of Tennessee, and data analysis undertaken to determine associations of demographic and workplace factors with the rate of injury. The research team invited 495 surgeons to complete an electronic survey and received completed surveys from 28% (n = 140) of the potential population. Of these, 61 surgeons (44%) reported they had sustained a work-related injury during their career. There was an association between length of career and prevalence of injury, with the majority of injuries occurring in surgeons with more than 21 years in practice. Injuries ranged from hand (25%), to lower back (19%), neck (10%), and shoulder (7%). While 10% of surgeons reported having to take time off work due to their work-related injury, only two thirds of surgeons reported that any institutional resources were made available to help with recovery from injuries.[1] While this is probably the only evidence surrounding occupational injury in orthopaedic surgeons, it paints a relatively bleak picture of high incidence and poor support for surgeons sustaining work-related injuries.

Freezing and biomarkers for bone turnover

■ While we are uncertain about the science (or indeed rationale) behind the practice of whole body cryotherapy following musculoskeletal trauma, the Italians certainly seem to be fans. The practice of cryotherapy involves an admittedly brief exposure to extreme cold (-110°C) in a cryochamber following sports injury. The therapy is supposed to reduce the effects of musculoskeletal trauma. Whatever your philosophical standpoint on treatments like this, sometimes the most unexpected results can turn up when examining some of the more alternative therapeutic approaches practised in allied specialties. Seeking to prove that cryotherapy has an effect on the musculoskeletal system, researchers undertook an investigation into the potential effects on serum biomarkers. Sports physicians in **Milan (Italy)** popped ten of the Italian national rugby team in the freezer for a spot of cryotherapy and, reasoning that if cryotherapy were to work it must have some measurable changes in serum biomarkers. Whole body cryotherapy (WBC) consists of a brief exposure to extreme cold air (-110°C) in a controlled chamber and it is applied in sports medicine to improve recovery from musculoskeletal trauma.[2] The aim of this study is to better define the beneficial effect of WBC on the musculoskeletal system of athletes, in particular on bone remodelling. Remodelling osteoimmunological biomarkers, OPG, RANKL and RANK were measured after WBC treatment in ten male rugby players. OPG levels were increased significantly, supporting the view that WBC induces an osteogenic effect. Further studies evaluating the effect of WBC on bone metabolism are desirable.

Herniation or degeneration first?

■ Despite the relative frequency of atraumatic intervertebral disc herniation the exact mechanism remains opaque. Although widely accepted that disc herniation is part of an ongoing degenerative process, this is in fact without scientific basis. A basic science research team in **Bristol (UK)** have tried to clear things up and shed some light on this chicken and egg situation. There is plenty of research to suggest that herniated discs can occur as part of a degenerative process and widely accepted basic science studies suggest tissue taken from herniated discs is not histologically normal. The counterpoint is that there are well defined degenerative processes that are known not to lead to herniation, and there is a plausible explanation as to how degenerative changes seen in resected disc tissue may follow herniation. Once the annulus is breached, a perfectly healthy disc is exposed to the outside environment. The high proteoglycan content has been demonstrated *in vitro* to swell within hours of escaping the disc and to rapidly exhibit the same degenerative structural changes one might expect to see should the disc have degenerated pre-herniation. In an excellent basic science study, the research team obtained ethical approval to examine both herniated and non-herniated degenerative disc tissue normally excised during spinal surgery. A thorough analysis including histological grading, immunofluorescence and confocal microscopy were employed to answer the study question. The research team were able to examine 21 herniated and 11 non-herniated discs to establish what the degenerative changes were (if any). The research team examined each tissue type separately (nucleus, inner and outer annulus) to establish in which direction the degenerative changes had occurred. In the

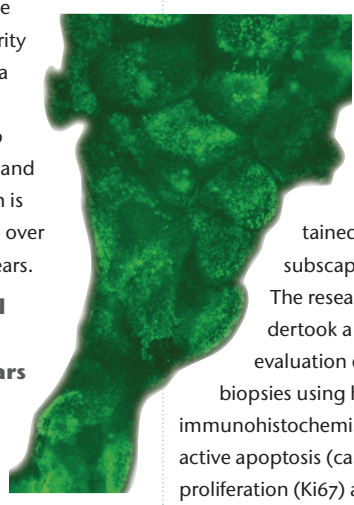
herniated tissue there was significantly greater proteoglycan loss in the outer annulus and neovascularisation in the nucleus than in the degenerative discs. In 21 of the 32 examined discs there was evidence of more advanced degenerative change in the outer tissue than in the inner. There were no significant differences in the magnitude of degenerative changes between the herniated and degenerative discs.[3] Taken as a whole, the authors of this study feel that disc degeneration does not necessarily occur secondarily to degeneration in all cases. They point out that one would expect greater degenerative changes in the nucleus than in the inner and outer annuli as this is where degenerative changes are known to start. While not conclusive, the authors have certainly established that the progression of degenerative change to disc herniation is far from certain.

MARS MRI and metallosis

While the subject of much ongoing debate in the general press, scientific literature and even at a government level, there is still considerable deliberation surrounding the diagnostic criteria for, and intervention indications in the monitoring of, metal-on-metal hip replacements. In the UK the Medicines and Healthcare Products Regulatory Agency (MHRA) recommends that cross-sectional imaging be undertaken in all patients with symptomatic metal-on-metal replacements. In many centres, high risk prostheses are undergoing cross-sectional imaging (usually MRI scanning with a metal artefact suppression sequence (MARS MRI)). While the signs of an adverse metal ion response are well defined on MRI scanning, there is little data to support decision making in equivocal cases and specifically the value of interval MRI scans is unknown. Researchers from **Norwich (UK)** have investigated the value of interval scans in the decision-making process surrounding metal-on-metal hip replacement. The research team designed a retrospective cohort series to characterise the natural history of adverse metal ion disease in a population of 545 patients (650 THRs). These patients received an Ultima MOM hip replacement, known to have an extremely high revision rate. Of these, 37 had been revised prior to MRI scanning, and a further 81 were revised following their first scan. Of the remaining patients, 103 THRs (80 patients) had at least two MRI scans available for review. Over the nine-year period of the study, 80 initially asymptomatic patients underwent a total of 239 MRI scans of their metal-on-metal hip replacement. Initially 63% of MRI scans were found to be normal and throughout the study period 9.5% of these demonstrated subsequent signs of disease. In total, just 15% of repeated cross-sectional imaging demonstrated signs of disease progression.[4] In this large case series, the majority of patients who had a normal MRI scan did not go on to develop disease progression, and if disease progression is evident it takes place over a period of several years.

Programmed cell death in partial thickness cuff tears

There are numerous studies published on treatment and diagnosis techniques in patients with rotator cuff tears, covering almost all aspects of the pathology. Where the literature is lacking is in papers that describe the biological aspects of rotator cuff pathology. This paper presents the results of investigations into the possible role of apoptosis in cuff tendinopathy, a poorly understood topic. The paper suggests that increased apoptosis, as found in these tendons, could represent a possible target for therapeutic intervention. There is emerging (and well established) evidence that tendinopathies like rotator cuff disease are not simply 'degeneration', 'overuse' or 'traumatic' tendinopathies, and that there is likely an active, ongoing, biological process which may well be triggered by an insult, but is a disease in itself. Much previous work has focused on the matrix biology of tendinopathies, but there is little evidence characterising the effects on the tenocytes themselves. Researchers in **Oslo (Norway)** have satisfied their academic curiosity and added another small piece to the jigsaw of rotator cuff pathology. Reasoning that there is little evidence supporting (or indeed rejecting) the role of apoptosis in the tendinopathy process associated with rotator cuff pathology, they designed a basic science study to evaluate the potential role for apoptosis in partial thickness rotator cuff tears. The researchers took biopsies of the supraspinatus tendons of nine partial thickness supraspinatus tendons and ten control samples (obtained from un-torn subscapularis tendon). The research team undertook a comprehensive evaluation of the tendon biopsies using histology and immunohistochemistry to detect active apoptosis (caspase-3, Asp175), proliferation (Ki67) and active cell death (p53 expression). There were significantly increased levels of p53 expression in the diseased tendons, suggesting higher levels of active apoptosis and evidence of higher rates of proliferation in the diseased tendons. The researchers conclude that apoptosis is likely involved in early tendinopathy.[5] In the setting of higher levels of proliferation, we wonder if this high turnover is central to early tendinopathy.



Lead glasses for trauma surgery?

One of the recurring themes in the orthopaedic literature is that of the risks of radiation exposure. At various times, recommendations have included the use of lead gloves and thyroid shields, which have met with variable uptake amongst orthopaedic surgeons. Despite the fate of the early radiologists, very few orthopaedic surgeons appear to be overly worried by the occasional inadvertent 'hand x-ray'. Surgeons in **Concorde (USA)** have investigated yet another potential unwanted radiation dose. Using a patient model and surgical phantoms, the investigators posed the question: does radiation exposure at the ocular lens (which is known to cause cataracts) warrant the use of leaded glasses which are recommended in some countries?[6] Their simple experiment demonstrated that the use of leaded glasses reduced the radiation exposure to the phantom's eye by a factor of ten, although there was much greater variation associated with radiographic projection (250-fold) than with the use of glasses. The investigators recommend the use of fluoroscopic leaded glasses to reduce radiation exposure to the ocular lens.

Smoking inhibits bone healing

It is always tempting as a doctor when things have not gone right for a patient to 'blame the patient'. When an explanation for a poor outcome lies in a potentially socially stigmatising habit (smoking, drinking or drug taking) it becomes the most attractive explanation. This may in part explain the enthusiasm with which some clinicians explain to patients that smoking inhibits bone and wound healing and that any blame for their delayed/nonunion may in fact lie directly on the patient's lap. Researchers in **London (UK)** decided to look for the truth behind the bunny rabbit studies and conducted a rigorous review using the PRISMA methodology. The review team were able to include nine studies in their review, of which five of the nine concluded that smokers took longer to heal than non-smokers. The heterogeneity in study design and outcome methods made pooling of the data for meta-analysis impossible, although there is enough

conclusive data to suggest that smoking negatively impacts healing of the tibia. The review authors noted that several of the studies included in their review contained other interesting information. One review included information supporting the hypothesis that smokers may be at increased risk of osteomyelitis, and a further study identified ex-smokers as also at an elevated risk of fracture nonunion (as compared with non-smokers, but lower risk than current smokers) even though they had given up smoking.[7] For such a widely quoted 'fact', the evidence presented in this review is mediocre to support a clinically relevant impact on long bone union rates in smokers. In established nonunion it is important to minimise risk factors prior to further surgery. We are not sure the evidence, as presented in this review, really stacks up in the way some clinicians and authors would have us believe.

Optimising polyethylene microstructure

While polyethylene may not be as exciting as some of the newer bearing structures, there is rapid ongoing development in the polymer itself and the preparation process. Recent years have seen the advent of standard 'cross-linked' polyethylene, heat-melt-anneal polyethylene, vitamin C polyethylene and finally 'textured' polyethylene. All of these techniques are aimed at optimising the polyethylene's mechanical characteristics. The process of 'texturing' polyethylene involves the application of controlled tension forces prior to cross linking to improve the mechanical properties of the material. The tension affects the microstructure of the material by altering the molecular alignment of the polyethylene polymers. Researchers in **Esch-sur-Alzette (Luxembourg)** aimed to establish if the microstructure of UHMWPE really does evolve with tension, and also to establish if the new microstructure (texture) increases strength and toughness. The researchers used a scanning electron microscope method to characterise the local strength and toughness of the undeformed UHMWPEs using a nanoscratch test technique. The research team determined the scratch characteristics in deformation mode, co-efficient of friction and viscoelastic recovery. The pre-texturing characteristics of the UHMWPE were a co-efficient of friction 0.64 to 0.68, with no cracking and viscoelastic recovery of 0.58 to 0.60. Following the texturing procedure the microstructure had increased strength (0.78) and decreased toughness (0.77) in line with the fibrils, while parallel to the fibril axis there was severely decreased strength (0.53) and increased toughness (0.55).[8] The authors concluded that texturing UHMWPE results in a fibre composite with high strength and toughness in well-defined directions. The authors comment that this potential to manipulate the properties of polyethylene opens the potential for improvement in the wear and tensile properties of the poly, however, the effects this may have when cross-linked is not known, and further work is definitely required.

REFERENCES

1. **Davis WT, Sathiyakumar V, Jahangir AA, Obremskey WT, Sethi MK.** Occupational injury among orthopaedic surgeons. *J Bone Joint Surg [Am]* 2013;95-A:1071-6.
2. **Galliera E, Dogliotti G, Melegati G, et al.** Bone remodelling biomarkers after whole body cryotherapy (WBC) in elite rugby players. *Injury* 2013;44:1117-21
3. **Lama P, Le Maitre CL, Dolan P, et al.** Do intervertebral discs degenerate before they herniate, or after? *Bone Joint J* 2013;95-B:1127-33.
4. **Ebreo D, Bell PJ, Arshad H, et al.** Serial magnetic resonance imaging of metal-on-metal total hip replacements: Follow-up of a cohort of 28 mm Ultima TPS THRs. *Bone Joint J* 2013;95-B:1035-9.
5. **Lundgreen K, Lian Ø, Scott A, Engebretsen L.** Increased levels of apoptosis and p53 in partial-thickness supraspinatustendon tears. *Knee Surg Sports Traumatol Arthrosc* 2013;21:1636-41.
6. **Burns S, Thornton R, Dauer LT, et al.** Leaded eyeglasses substantially reduce radiation exposure of the surgeon's eyes during acquisition of typical fluoroscopic views of the hip and pelvis. *J Bone Joint Surg [Am]* 2013;95-A:1307-11.
7. **Patel RA, Wilson RF, Patel PA, Palmer RM.** The effect of smoking on bone healing: a systematic review. *Bone Joint Res* 2013;2:102-11.
8. **Addiego F, Buchheit O, Ruch D, Ahzi S, Dahoun A.** Does texturing of UHMWPE increase strength and toughness: a pilot study. *Clin Orthop Relat Res* 2011;469:2318-26.