

that it doesn't really matter what implant or combinations of implant are in use – it's simply the quality of the surgery that matters.

REFERENCES

1. Goudie EB, Clement ND, Murray IR, et al. The influence of shortening on clinical outcome in healed displaced midshaft clavicular fractures after nonoperative treatment. *J Bone Joint Surg [Am]* 2017;99-A:1166-1172.

2. Tamaoki MJS, Matsunaga FT, Costa ARFD, et al. Treatment of displaced midshaft clavicle fractures: figure-of-eight harness versus anterior plate osteosynthesis: a randomized controlled trial. *J Bone Joint Surg [Am]* 2017;99-A:1159-1165.

3. Leighton R, Watson JT, Giannoudis P, et al. Healing of fracture nonunions treated with low-intensity pulsed ultrasound (LIPUS): A systematic review and meta-analysis. *Injury* 2017;48:1339-1347.

4. Patterson JT, Morshed S. Chemoprophylaxis for venous thromboembolism in operative

treatment of fractures of the tibia and distal bones: a systematic review and meta-analysis. *J Orthop Trauma* 2017;31:453-460.

5. Shoji K, Heng M, Harris MB, et al. Time from injury to surgical fixation of diaphyseal humerus fractures is not associated with an increased risk of iatrogenic radial nerve palsy. *J Orthop Trauma* 2017;31:491-496.

6. Roden-Foreman K, Solis J, Jones A, et al. Prospective evaluation of posttraumatic stress disorder and depression in orthopaedic injury patients

with and without concomitant traumatic brain injury. *J Orthop Trauma* 2017;31:e275-e280.

7. Yoon BH, Ko YS, Jang SH, Ha JK. Feasibility of hip fracture surgery using a no transfusion protocol in elderly patients: a propensity score-matched cohort study. *J Orthop Trauma* 2017;31:414-419.

8. Lau S, Guest C, Hall M, et al. Functional outcomes post Lisfranc injury-transarticular screws, dorsal bridge plating or combination treatment? *J Orthop Trauma* 2017;31:447-452.

Oncology

Allograft augmented with intramedullary cement after resection of a diaphyseal tumour

■ Surgeons in Mount Sinai Hospital, **Toronto (Canada)** have reported their own experience of augmented plate reconstruction with allograft following resection of diaphyseal tumours.¹ The technique in question involves the use of intercalary allograft and subsequent cement augmentation to create a cement plate fixation construct following tumour excision. This offers a flexible alternative to a megaprosthesis in the limb salvage situation. Although a well recognised technique, there are few long-term studies reporting survival or functional outcomes, and we were delighted here at 360 to read this report of nearly 50 patients, all managed using this technique. This study team reports a prospective cohort series of 46 patients with intercalary allografts augmented with intramedullary cement and fixed using compression plating. Outcomes were evaluated for long-term functional status using the Musculoskeletal Tumor Society (MSTS) scoring system and the Toronto Extremity Salvage Score (TESS). The most common diagnoses were osteosarcoma (n = 16) and chondrosarcoma (n = 9), with the usual pattern of tumour location (femur in 21, the tibia in 16 and the

humerus in nine). At a median follow-up of 92 months, overall survival of the allograft was an impressive 84.8%. A total of 15 patients (33%), however, had experienced at least one complication. Five allografts were revised for complications and one for local recurrence. The authors concluded that intercalary allografts augmented with intramedullary cement and compression plate fixation provide a reliable and durable method of reconstruction after the excision of a primary diaphyseal bone tumour. While it is unlikely that there will ever be a single benchmark in limb salvage and tumour reconstruction, given the variety of defects, primary diagnoses, and patient and surgeon expectations, this study does support the use of augmented intercalary allograft with cement and plate fixation. This technique is certainly one that has a place in modern orthopaedic oncology.

Non-vascularised fibular grafts for reconstruction of segmental and hemicortical bone defects following meta-/diaphyseal tumour resection of the limbs

■ One of the difficulties faced by tumour surgeons in limb reconstruction is that a relatively poor vascular supply causes difficulties with local flaps, and therefore causes restriction in the range of reconstructive

options available. One option used is that of a fibular graft, either vascularised or not. It is certainly a matter of opinion whether or not vascular reconstruction is necessary in this setting, and if indeed this makes a difference in the long term. However, use of the vascularised option does, to a certain extent, dictate surgical availability, as the pedicle must be reconstructed with a suitable anastomosis. We were delighted to see this series of patients from **Basel (Switzerland)**.² The authors report 36 patients, all of whom were treated with non-vascularised fibula for segmental (n = 15) and hemicortical reconstructions (n = 21) after bone tumour resection (15 malignant, 21 benign) in the limbs. At a final mean follow-up of 8.3 years, union was achieved radiologically in 94% of patients, and 85% showed apparent hypertrophy at the graft-host junction. The overall complication rate was somewhat high at 36%, with four patients (11%) developing local recurrence. The authors report a relationship between the development of mechanical complications (fracture, delayed union/nonunion) and a defect size of ≥ 12 cm. Encouragingly, the dual functional outcome was highly satisfactory (mean MSTS score 86%). The authors here concluded that non-vascularised fibular reconstructions should be considered a valuable

alternative treatment option for patients with hemicortical defects or segmental reconstructions of less than 12 cm in which no additional neo-/adjuvant treatment is necessary. Reporting here a combination of segmental and hemicortical defects makes interpretation of these results somewhat more challenging than the average paper. Only six of the 36 cases received adjuvant therapy (which is on the low side for malignant tumours), hence their comment (based on their experience of six cases) that "this is a valuable addition 'only' in patients in which no additional neo-/adjuvant treatment is necessary". This may be a bit overstated from the data. An important recommendation the authors do make, however, is that "Taking our own results into account, we therefore strongly recommend the use of vascularised fibula grafts for segmental bone defects of 12 cm or greater." This can serve as a useful guideline in clinical practice.

Pasteurised autograft-prosthesis composite reconstruction may not be a viable primary procedure for large skeletal defects after resection of sarcoma

■ Among various types of composite biological reconstruction agents, pasteurised autograft-prosthesis composite (PPC) is popular when allograft is unavailable. The

technique involves a combination of reconstruction using sterilised autograft and a megaprosthesis. The rationale is that, given time, the autograft will act as a framework and undergo creeping substitution, resulting in incorporation of the pasteurised autograft into the patient's skeleton having eradicated the tumour. This review of 142 PPCs is a timely paper, casting light on the factors associated with the survival or failure of a PPC. Investigators in **Seoul (South Korea)** report the 20-year survival rate of 142 PPCs, which was a not terribly impressive 40%.³ Within the follow-up period of the series, 52 PPCs went on to fail. Patients in whom failure had occurred later underwent revision to a tumour prosthesis in about 40% and arthrodesis in 20%, and then 10% of each resulted in pseudarthrosis or amputation. The risks for failure in the series were larger tumours, longer lengths of pasteurised bone and, perhaps surprisingly, male gender. The results of this series are clearly well below expectations, both in terms of previous reports of similar techniques and compared with other limb salvage approaches. We wonder if surgeons would be better undertaking other types of limb salvage in patients with large defects, as it is difficult, based on these results, to recommend this as an acceptable approach.

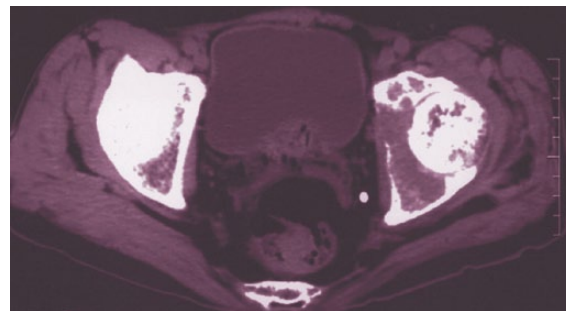
Time to development of radiation-induced sarcomas: a multicentre study

■ Radiation-induced sarcomas (RIS) are a significant burden to patients and healthcare systems. However, very little is known about their development and its bearing on outcomes. Orthopaedic oncologists from **Sydney (Australia)** have presented their own large retrospective cohort study of radiation-induced sarcoma cases, which have been assembled from across five large international sarcoma centres.⁴ The paper focuses on the results of 419 patients, all presenting

with a radiation-induced sarcoma. The study was designed to establish what the risk factors were for the development of RIS. The key findings were that that radiation in older age (hazard ratio (HR) 2.11) and chemotherapy for the first malignancy (HR 1.61) were independently associated with a shorter time to development of RIS. Subjects treated with chemotherapy had a median interval to RIS development of eight years, compared with 14 years in those who were chemotherapy-free, thus confirming an association between chemotherapy given for the first malignancy and a shorter time to development of RIS. The dose of radiotherapy was not associated with interval to RIS. One of the potentially significant confounding effects of this study is that patients may have been selected to receive combined modality treatment at diagnosis because they had a higher-grade, or more aggressive, primary malignancy in the first place, compared with those who did not have chemotherapy. These patients are more likely to have a mutation in tumour suppressor or DNA repair genes, which not only predisposes them to their aggressive primary cancer, but may also place patients at higher risk of, and with shorter timeframes to, development of a RIS.

Enchondromas and low-grade chondrosarcomas: perpetually confused?

■ One of the ongoing difficulties in orthopaedic oncology is in distinguishing between low-grade chondrosarcoma and enchondromas, with orthopaedic oncologists ever hopeful that novel MRI sequences will result in greater diagnostic accuracy. After all, an enchondroma is usually relatively innocent and a chondrosarcoma, low-grade or not, may not be. Colleagues in **Birmingham (UK)** have set out to identify the roles of clinical review, and conventional and dynamic contrast-enhanced MRI in making that key diagnostic



distinction between enchondroma and chondrosarcomas of long bones.⁵ This paper focuses on the results of 60 patients, all with chondral tumours of various varieties. Based on final diagnosis, the cohort consisted of 27 enchondromas, ten cartilaginous lesions of unknown malignant potential, 15 grade 1 chondrosarcomas and eight high-grade chondrosarcomas. Clinical and imaging findings were compared with eventual histopathological grading. The distinguishing features between enchondromas and grade 1 chondrosarcomas were pain attributed to lesion, tumour length, endosteal scalloping, cortical destruction, bone expansion and soft-tissue mass. However, in this series, dynamic contrast-enhanced MRI could not make a distinction between enchondromas and grade 1 chondrosarcomas. This is essentially another paper showing how difficult it is to differentiate low-grade chondrosarcomas from enchondromas. We suspect this will be an ongoing and difficult problem, and it may be one that is never solved.

F-18 FDG PET perhaps the answer?

■ Staying with the theme of differentiating between benign and malignant cartilage tumours, this group from **Miami, Florida (USA)** undertook a comprehensive systematic review with the aim of quantifying the diagnostic accuracy of 18F-fluorodeoxyglucose Positron Emission Tomography / Computed Tomography (F-18 PET/CT) in discriminating between benign and malignant chondral lesions.⁶ The

comprehensive review of literature identified 811 potential articles; however, just eight of these describing 166 lesions were included in the final review. The authors evaluated age, gender, tumour size, histologic grade, and maximum standardised uptake values (SUVmax) for each individual lesion and compared them with the outcomes of benign, low-grade intermediate and high-grade chondral neoplasms. Within this aggregate cohort, there were 101 patients with SUVmax values available, and 65 were therefore reported using aggregate data. The authors identified that benign tumours are more commonly found in females but that malignancy was not associated with patient age or size of lesion. With regard to the SUVmax results, PET/CT was able to distinguish between high-grade and low-grade tumours, however, it was much less useful in the division between benign and malignant lesions. In fact, with the mean SUVmax of 1.6 in benign lesions *versus* 2.0 in low-grade lesions, this really can be argued to be a non-discriminatory test. While we would not necessarily agree with the strongly positive conclusions reached by the authors of this paper regarding the use of PET/CT, this is not to say that PET/CT has no value, as clearly the data here would suggest that it can be used to distinguish between high-grade and other lesions. This paper supports the expected findings that SUVmax is higher with higher-grade lesions, but not helpful for differentiating between benign and low-grade cartilage lesions, but does it really matter?

Intralesional resection for central grade 1 chondrosarcoma

■ The confusion surrounding the diagnosis and management of chondrosarcoma is not restricted to the value of imaging modalities in reaching the diagnosis. There is again much debate on the best treatment methods - proponents of intralesional methods argue that this can be safely undertaken without the risk of morbidity associated with more extensive reconstructions and without exposing the patient to unnecessary risk of recurrence. These authors from **Beijing (China)** have published an updated review and meta-analysis with the aim of establishing whether there is an excess mortality associated with intralesional resection versus wide local margin resection

in patients with central grade 1 chondrosarcoma.⁷ The authors were able to identify ten studies reporting the outcomes of 394 patients in the literature. This included 214 patients treated with intralesional resection and 180 patients treated with wide local excision. There were some surprisingly marked differences in the results. Patients treated with intralesional resection had a significantly lower complication rate and better functional outcomes. Reassuringly, there were no significant differences in terms of overall local recurrence. This paper essentially shows that, on the face of it, curetting out a grade 1 chondrosarcoma is safe. However, this does not take account of potential issues with patient selection, so patients with more 'worrying' features may well have undergone

resection. The main concern is that if a low-grade chondrosarcoma recurs, it will do so at a higher grade and may then metastasise. This can take many years. A pinch of salt should therefore perhaps be taken when interpreting these results.

REFERENCES

1. Gupta S, Kafchinski LA, Gundle KR, et al. Intercalary allograft augmented with intramedullary cement and plate fixation is a reliable solution after resection of a diaphyseal tumour. *Bone Joint J* 2017;99-B:973-978.
2. Lenze U, Kasal S, Hefti F, Krieg AH. Non-vascularised fibula grafts for reconstruction of segmental and hemicortical bone defects following meta-/diaphyseal tumour resection at the extremities. *BMC Musculoskelet Disord* 2017;18:289.
3. Lee SY, Jeon DG, Cho WH, et al. Pasteurized autograft-prosthesis composite reconstruction

may not be a viable primary procedure for large skeletal defects after resection of sarcoma. *Sarcoma* 2017;97:10964.

4. Zhang AY, Judson I, Benson C, et al. Chemotherapy with radiotherapy influences time-to-development of radiation-induced sarcomas: a multicenter study. *Br J Cancer* 2017;117:326-331.
5. Douis H, Parry M, Vaiyapuri S, Davies AM. What are the differentiating clinical and MRI-features of enchondromas from low-grade chondrosarcomas? *Eur Radiol* 2017 (Epub ahead of print) PMID: 28695356.
6. Subhawong TK, Winn A, Shemesh SS, Pretell-Mazzini J. F-18 FDG PET differentiation of benign from malignant chondroid neoplasms: a systematic review of the literature. *Skeletal Radiol* 2017;46:1233-1239.
7. Chen X, Yu LJ, Peng HM, et al. Is intralesional resection suitable for central grade 1 chondrosarcoma: a systematic review and updated meta-analysis. *Eur J Surg Oncol* 2017;43:1718-1726.

Children's orthopaedics

X-ref For other Roundups in this issue that cross-reference with *Children's orthopaedics* see: *Hand Roundup 7; Spine Roundup 4.*

Acetabular anatomy in slipped capital femoral epiphysis

■ It is still not entirely clear what the mechanical and other factors are that result in slipped capital femoral epiphysis (SCFE). Although there are some clearly defined and widely accepted risk factors (such as hormonal imbalance, age and obesity), it is likely that some biomechanical factors are also a risk. Currently, the established view is that over-coverage of a femoral head (particularly by a deep and retroverted acetabulum) might be one significant biomechanical risk factor for the development of a SCFE. However, there is little evidence to support this view one way or the other. This study from **Düsseldorf (Germany)** reports on acetabular anatomy in 36 patients with SCFE.¹ The authors matched the patients

to 36 controls by gender and age, and compared various anatomical characteristics as determined by CT in both age groups. The meat of the paper was the determination of acetabular depth-width ratio (ADR), the lateral centre-edge angle (LCEA), anterior and posterior acetabular sector angle (ASA), and version. There was a significantly lower coronal ADR in the SCFE cohort compared with the contralateral hips but this did not differ from the controls. However, the mean LCEA was lower in the SCFE hips than in the contralateral hips. In essence, these authors report acetabular retroversion as the primary abnormality seen, and there was no real evidence of an increase in acetabular depth. This anatomical information may have implications for reconstruction surgery. However, it is unknown whether the decreased acetabular version is a primary or secondary deformity.

Assessing symbrachydactyly

■ This is a very good article on the functional assessment of children

and adolescents with unilateral symbrachydactyly, a rare and challenging condition to assess. We were interested to read this article from **Sacramento, California (USA)** where the authors had grouped their patient cohort by the presence or absence of opposable digits.² The patients underwent assessment of pinch grip, bimanual activity performance, activities of daily living (ADL) performance and psychosocial status. The authors also report subjective rating of the appearance and function of the hands from both participants and parents. The groups did not differ in terms of numbers of outliers with pinch grip strength; however, there was a significantly higher average pinch grip strength (2.4 kg vs 4.1 kg) in the opposable digit group. In addition to this, patients without opposable digits were less likely to use their affected hand in bimanual activities, although there were no differences in patient- and carer-related satisfaction with hand function. Nor were there any

apparent differences in numbers of ADL that were not achievable in either group. The authors insightfully report that "stable, opposable border digits enable complex hand function, incorporation into bimanual activities and the ability for increased in-hand manipulation." This article provides information not only for clinicians, but also for parents to understand what level of function is achievable and what the potential benefits of surgery might be.

Flexible nailing of paediatric femoral fractures X-ref

■ Flexible intramedullary nailing has become a mainstream technique for treating long bone shaft fractures in children. The nails can be inserted using different entry points and directions, and previous work has identified the need to achieve a stable fixation by tensioning the nails against each other. Different entry points have their relative pros and cons and, although there are a wide variety of techniques, there are precious few comparative studies from