

ROUNDUP³⁶⁰

Children's orthopaedics

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In with the old: plaster wedging in paediatric forearm fractures **x-ref**

■ The pendulum is swinging away from operative treatment of both bone forearm fractures, with recent papers highlighting remodeling potential and excellent outcomes even for relatively poor reductions in the distal radius. It is therefore perhaps not surprising that a return to conservative treatment is starting to creep proximally up to the forearm. Researchers in **Columbus (USA)**, unusually for a US-originating paper, are revisiting a conservative treatment regime mostly confined to yesteryear. In their centre, cast wedging is routinely used in both bone forearm fractures that have either a mal-reduced fracture or loss of reduction. The paper, although described as 'prospective', is in fact a retrospective analysis of prospectively collated data. The study population consists of all children treated with a forearm fracture over a 15-month period. The study reports the outcomes of 2,124 forearm fractures. During the course of the study, 79 fractures were treated with cast wedging for mal-reduction or loss of reduction of the fracture. Wedging resulted in sustained significant improvement in fracture angulation until healing was observed. There were no major complications and only one failure in this select

group.¹ This simple paper highlights the value of cast wedging in a selective group of patients with early slip or failure of reduction in both bone forearm fractures being treated with plaster cast.

Medial approach for DDH safe, but not better

■ It's the commonly held opinion of many that an early medial open approach for reduction of the dislocated developmental dysplasia of the hip (DDH) carries with it a higher risk of avascular necrosis (AVN) than a later anterior open approach. The counter argument is that by facilitating an earlier reduction, the medial approach allows for better remodeling potential. Surprisingly, there is no comparative data to support either viewpoint. This to-the-point paper from **Bristol (UK)** set out to establish if there were differences in the AVN rate or acetabular remodeling with either approach. The research team constructed a comparative cohort series including 48 patients who all underwent open reduction for DDH through either a medial (n = 26, mean age 11 months) or anterolateral (n = 22, mean age 18 months) approach. Radiological outcomes assessed included osteonecrosis of the femoral head, acetabular index and centre-edge angle. The authors demonstrated no differences in AVN rate (p = 0.52, 12% vs 18% in favour of the medial approach) and no difference in acetabular remodeling (p = 0.18).² In this case, certainly, it appears that it's "horses for courses" and neither approach is superior to the other.

Ponseti – but not as he knew it?

■ The Ponseti method is the most widely used method of correction for congenital talipes equinovarus (CETV). The hugely popular splinting and casting method has been so widely adopted across the globe that deviations from the original protocol are commonplace. A study team in **Shanghai (China)** designed a systematic review with the aim of establishing if these subtle changes in protocol translated into changes in outcomes. The review team aimed to determine primarily to what degree the Ponseti method was followed in terms of manipulation, casting, and percutaneous Achilles tenotomy. They also set out to establish whether there was variation in the bracing type and protocol used for relapse prevention, and finally if the same criteria were used to diagnose and manage clubfoot relapse in the 19 papers that met the authors' inclusion criteria. Surprisingly, the review team found poor documentation of the method employed to correct the clubfoot deformity in 11 of the 19 papers. However, they were able to establish that the core principles were not followed in three studies, seven studies used the correct brace, and in four studies the brace used was completely different to the brace proposed in the original method. In 15 studies brace protocols were described precisely, however, in three of these the protocols were presented differently. The criteria for judging brace compliance was de-

scribed in only eight studies and the criteria in each study were different.³ The definition of relapse was inconsistent and, although introduced, it varied in eight studies and in seven the indications for re-intervention were different. In addition, the intra-articular surgical rate differed significantly. Although the authors of this review recommend strict adherence to the Ponseti protocol, this review highlights the problems of comparing studies that propose the use of one particular technique when that technique is subject to significant variation between institutions. Given the widely consistently good results published with variations on the Ponseti method, whilst a nightmare for authors of meta-analysis, it does beg the question: are the details perhaps not as important as we like to think they are?

Salter osteotomy more accurate than Pemberton in DDH

■ While a common condition with plenty of short- and long-term cohort studies, there are surprisingly few comparative cohort or clinical trials in developmental dysplasia of the hip (DDH) on which to form an evidence base for effective treatments. We were delighted to see a recent paper from investigators in **Taipei (Taiwan)** with a comparative series of patients undergoing two different interventions for their DDH. This comparative case series concerns a series of 42 patients followed to a satisfactory minimum of ten years' follow-up (mean 18 years).

Patients were all treated for a primary diagnosis of DDH with either a Salter (n = 14) or Pemberton (n = 28) acetabular osteotomy between 12 and 36 months of age. The study was designed to establish the radiological outcomes of the two different osteotomies at long-term follow-up. Outcomes were assessed with a range of radiological and clinical measures. Radiological markers included vertical centre-anterior margin angle, anterior acetabular head index and weight bearing zone. The acetabular index was calculated as a radiological parameter ratio (the division of each radiological measurement of the operative side by that of the non-operated side). Clinical outcomes were assessed using SF-36 and Harris hip score questionnaires at follow-up.⁴ The authors found no differences in the radiological parameters between the operated and non-operated hip in the Salter group. In contrast, the Pemberton group had increased anterior acetabular coverage in the operated side (6°) compared with the non-operated side (12°; p = 0.001). There were no differences in the SF-36 or Harris hip score, however, three patients in the Pemberton group had an anterior impingement sign in the hip. These data suggest that it is easier to overcorrect anterior coverage in DDH with a Pemberton than a Salter osteotomy and therefore care should be taken in choosing the type of osteotomy and the degree of correction necessary.

Is the open paediatric fracture an emergency?

■ As highlighted (and discussed in much detail previously in *360* 2013;2;2-7) the timing of debridement in severe and less severe open fractures is very much a matter of debate. National guidelines in England and Wales suggest the majority of uncontaminated open fractures can be managed in a planned manner and may well be better managed 'the next day' by an experienced and fresh team. There is, however, little in the way of guidance for paediatric orthopaedic trauma surgeons.

Can the child's open fracture wait until the next day? Researchers in **Doha (Qatar)**, vexed by precisely the same question, were keen to review the available literature and find an answer to this important but unclear question. The review team performed an extensive systematic review and meta-analysis using a random effects model to pool odds ratios for a comparison of infection rates between children undergoing early (< 6 hrs from time of injury) and late (> 6 hrs) surgical debridement having sustained an open fracture. The research team identified 12 studies published on the topic, but only three studies encompassing 714 fractures were suitable for inclusion in the review. The pooled odds ratio (OR = 0.79) for infection between late and early surgical debridement was in favour of late surgical debridement but this difference was not, however, statistically significantly different (95% CI 0.32, 1.99; p = 0.38). Similarly, the researchers found no significant difference in the rates of infection between paediatric open fractures of the upper and lower limbs.⁵ The authors conclude that 'the cumulative evidence does not, at present, indicate an association between late surgical debridement and higher rates of infection in paediatric open fractures.' While we would wholeheartedly agree that this is the current state of play, the evidence used to make this statement is poor. Many factors need to be considered when planning timing of surgical debridement of open fractures and it seems sensible to us at *360* HQ to consider an urgent, next available operating list approach, dependent upon the clinical situation. There is a general shift within the profession away from the dogma of immediate surgical debridement, particularly in the 'in-out' grade one upper limb

open fractures, with some clinicians choosing to manage this injury purely non-operatively, although good quality evidence is lacking.

Bang up-to-date with femoral external fixation x-ref

■ Femoral external fixation is not really in vogue at the moment. Children with open physes and displaced femoral shaft fractures are more often treated with elastic stable intramedullary nailing or locking plate constructs in most specialist paediatric centres. However, external fixator technology has also moved on. The advantages of early full



weight-bearing combined with improved technology to minimise pin site problems is starting to re-awaken interest in what is, after all, a tried and proven technology. Surgeons in **Newark (USA)** have shared their experience of a single surgeon series of 289 paediatric femoral fractures managed in a level 1 trauma centre. Of these, the study team identified 31 patients (11%) treated with an external fixator.

Patients were treated in this manner if they were axially unstable, metadiaphyseal fractures, re-fractures and pathological fractures. Ten patients were then excluded (six inadequate follow-up, four treated in combination with ESIN), leaving 21 patients for detailed review. A mean follow-up of 17 weeks (9 to 24 months) was achieved, and for the most part satisfactory alignment was achieved, although there was a very small leg length discrepancy in the majority of cases (mean 7 mm, exceeded 20 mm in one patient).⁶ This paper is a helpful overview of the technique and includes useful tips for the trauma surgeon involved in the care of the paediatric patient. It is an uncontrolled case series but has a useful message in that the quoted complications of re-fracture and leg length discrepancy do not appear to have been a significant issue in this group.

This paper is of interest to us, here at *360*, as perhaps a more balanced view in the broader literature is required with treatment of axially unstable fractures. Although ESIN is a convenient proven management strategy for the majority of patients, it is not suitable for all fracture configurations and the venerable external fixator perhaps shouldn't be consigned to the store room just yet.

Indomethacin, heterotopic ossification and cerebral palsy hips

■ Treatment of recalcitrant femoral head dislocation in cerebral palsy can be a tricky and unrewarding task. While Botox, tendon releases and containment procedures are usually favoured in early disease, femoral head resection is often used as a last resort for those patients with completely unmanageable disease. Femoral head excision itself is a slightly controversial procedure with advocates and detractors, however, all agree that heterotopic ossification following the procedure can be a troublesome and difficult to treat complication. Surgeons in **London (UK)** were keen to see if the addition of indomethacin would influence the outcome of femoral head resection in terms of heterotopic ossification (HO). The authors designed a retrospective comparative case series (Level III evidence) in an attempt to establish what the effect of indomethacin is on HO formation in this clinical setting of 41 consecutive patients with 52 primary resections for severe pain. This study was conducted in two paediatric orthopaedic units, each following their own specific protocol. There were no real baseline demographic differences between the two groups and similar operative procedures were undertaken including myoplasty and post-operative management was identical (in particular, no patients were placed on traction, had spica cast or external fixator). In one centre the patients received prophylactic indomethacin 0.5mg/kg for ten days while the others did not. Outcomes were assessed through clinical review

and 'care giver assessment'. Gold standard in these circumstances for identification of HO formation was identified radiologically following the McCarthy classification. Five patients in each group developed heterotopic ossification but there did not appear to be any evidence of a treatment effect between groups. While this is a retrospective study and pain relief in this patient group is very difficult to assess, comparison studies like these are certainly of value.⁷ The conclusion that indomethacin does not appear to influence the rate or symptomatology of heterotopic ossification in these patients is a practical message for all surgeons involved in the management of this difficult to treat problem.

Lengthening nails for congenital femoral deformities

■ Femoral deformities associated with congenital limb deformity can be exceedingly difficult to treat. Requiring slow correction to avoid neurovascular compromise, many techniques have been described, including external and internal 'lengthening nails'. Despite the technical difficulties performing the surgery and the relative frequency of limb length discrepancies, there are surprisingly few reports concerning lengthening with nails for these deformities. Investigators in **Baltimore (USA)** report on the use of the PRECICE nail in a single centre series of congenital limb abnormalities over a 17-month period between January 2012 and May 2013. The study team was able to recruit 66 patients, all of whom were treated for either a congenital short or dysplastic femur. Of these 66 patients, the study team report on 21 treated with the PRECICE nail.⁸ The authors used the PRECICE nail for patients with length discrepancies of more than 2 cm which were suitable for treatment with an intramedullary

device (canal < 12.5 mm diameter and femur < 230 mm length). All patients also had to be infection free and be able to comply with the rehabilitation component of this treatment. The article is based on the results of just 18 patients (21 lengthenings) of the original cohort of 66. Results are reported with a minimum follow-up of six months (mean 16 months; 6 to 22) with a wide range of ages (mean age of patients was 19 years; 9 to 49). Lengthening of a mean of 44 mm in 16 femora and five tibiae was achieved. The study team have meticulously reported their methods including a detailed description of the operative technique and useful technical details about the management of the soft tissues using physical therapy and botulinum toxin. Patients underwent a comprehensive physiotherapy regimen and oral vitamin D was used to promote bone healing. The surgical team was able to achieve a healing index of 0.91 months/cm with no significant differences between the femur and tibia. There were seven additional procedures required (33%), including two for joint subluxation. Crucially, there were no reported mechanical failures and radiographs indicated that the external programmer performed in a predictable and planned manner, however, patients were left with some residual consistent loss of flexion of the hip, knee and ankle which had not recovered at the time of the most recent follow-up. This is a useful 'technical tips' paper for surgeons involved in lengthening in congenital limb abnormalities. These patients present a very difficult clinical challenge and the advantages of an internal device as opposed to an external device are well argued. The complications are expected and the paper gives a good description of their management. The satisfactory lengthening index must be put into context with consistent

joint contractures, and while the nail offers a more convenient and comfortable device, here at 360 we always take papers with declared received benefits with a slightly larger pinch of salt than average. This may introduce some bias but, nevertheless, the paper is balanced and well written with a useful message.

Is MRI the answer to imaging of the physis? [x-ref](#)

■ Despite numerous additions to Salter's original classification in the decades since the original publication of his classification, little has changed in the assessment of post-traumatic physeal injury in the child since the 1960s. With the advent of 3D imaging and particularly MRI scanning which does not carry with it the heavy radiation dose of CT, it is curious to us here at 360 that this elegant paper from **New York (USA)** has not been published before! The authors evaluate the use of MRI scanning to determine the proportion of physeal involvement following trauma. The authors recruited 24 consecutive patients who underwent MRI scanning to investigate a physeal bar or growth disturbance between 2006 and 2011. They used a validated semi-automated segmentation technique to establish the diagnostic value of MRI scanning in evaluating physeal damage. The 24 patients in the study (mean age 11.4 years; 5 to 15) had 25 physeal bars. The majority were located in distal tibia (9, 36%), proximal tibia (8, 32%) and distal femur (5, 20%). Although on the face of it sounding complex, the 3D-SPGR sequence and subsequent 3D mapping has been validated in a juvenile lapine model and the authors suggest that analysis could be achieved with "minimal" operator training requiring ten minutes per patient.⁹ Inter-rater reliability was excellent (Pearson correlation $r = 0.96$), as was the intra-class correlation coefficient

of 0.99 (CI 9.97-.99). The authors recognise the limitations of this study as retrospective and therefore subject to patient selection bias. The paper describes an elegant technique of physeal bar estimation and this would be of interest to surgeons involved in paediatric trauma and its consequences, limited only by the lack of commercial availability of the software package used to perform the analysis.

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