POSITIVE

OFFICIAL NEWSLETTER OF
THE PAEDIATRIC ORTHOPAEDIC
SOCIETY OF INDIA

THE URGENT NEED FOR MORE RESEARCH ON ASPECTS OF PAEDIATRIC ORTHOPAEDIC DISEASES IN INDIA

A lot of what we teach in the field of Orthopaedics in India is based on information from the Western literature. However, it is important to realise that some of the information may not be applicable to Indian patients. We cite a few examples.

While planning limb length equalization procedures we may need to establish the skeletal age of the child. Skeletal ages of children as determined from the Tanner's or Greulich & Pyle atlases, which are all based on data of Caucasian children, are likely to be very different from those of Indian children and hence are of little use. The ages of children at the onset of Perthes' disease and the natural history of the disease in India have been shown to be very different from that seen in the West. Hence, recommendations that suggest that ~ 60% of children with Perthes' disease do not need treatment, or those that suggest that operative containment after the age of 8 or 9 years is ineffective, are inappropriate in the Indian context.
The outcome of treatment of conditions like clubfoot or quadriceps contracture may be perceived very differently by patients in India. Achieving 90 degrees of flexion of the knee or ankle dorsiflexion upto neutral may be quite adequate for the Western child. Restoring a greater degree of knee flexion and ankle dorsiflexion may be very important in the rural Indian context where squatting is essential.

It thus becomes imperative that we collect normative data, study the differences in patterns of presentation and evolution of disease in our population and define outcome measures relevant to our society.

It is high time that POSI pays attention to this.

The Editors

Dec.
2002

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I**NFORMATION** ***V*****ERY**
E**FFECTIVELY**

ABSTRACTS

Contents

1. Arthrogryposis wrist deformities: Results of infantile serial casting. *Smith DW, Drennan JC.* Carrie Tingley Hospital, Albuquerque, New Mexico, USA . *Journal of Pediatric Orthopaedics, 2002;22:44-7.*

17 children with classical or distal arthrogryposis who had flexion deformities of the wrists were treated by serial casting and custom-made orthoses. In all patients the deformity of the wrist improved. The greatest improvement was noted after the first casting session. At follow-up (mean of 6 years) the deformity had recurred in 75% of the children with classical arthrogryposis. None of the children with distal arthrogryposis had recurrence of deformity and they were more independant functionally.

EDITORIAL COMMENT

The study demonstrates that the response to early stretching and casting is clearly different in distal arthrogryposis and classical arthrogryposis. Based on this report, it would be reasonable to suggest that a trial of serial casting should be instituted to correct wrist deformities in infants with arthrogryposis.

2. Position of immobilization for paediatric forearm fractures. *Boyer BA, Overton B, Schrader W et al.* Children's Hospital Medical Center of Akron, Akron, Ohio, USA. *Journal of Pediatric Orthopaedics, 2002;22:185-7.*

The study was undertaken to evaluate the effect of position of immobilization on residual angulation of distal third forearm fractures in children. 99 children were randomly allocated into three groups; 38 of whom were casted in neutral position, 26 in pronation of the forearm and 35 with the forearm supinated. Initial angulation and displacement of the fractures were compared with angulation and displacement after union of the fracture. The mean pre-reduction angulation was 20 degrees, the post reduction angulation was 3 degrees. The mean final angulation at union was 7 degrees. The degree of angulation was not affected by the position of immobilization.

EDITORIAL COMMENT

The traditional teaching of immobilizing distal third forearm fractures in pronation has been clearly challenged in this study. The well designed study clearly shows that the position of immobilization may not be as important as previously assumed. This information, regarding one of the commonest fractures encountered in paediatric orthopaedics, is very useful. The surgeon can safely ignore the position of the forearm while treating these fractures, and can pay closer attention to achieving a good reduction and applying a well moulded cast. In a previous issue of POSITIVE, we quoted Chess who demonstrated that chances of displacement of a fracture are minimal in a well moulded cast.

3. Response of the physis to leg lengthening. *Lee S-H, Szoke G, Simpson H.* Anam Hospital, Seoul, Korea. *Journal of Pediatric Orthopaedics 2001;10:339-43.*

The authors studied the response of the physis to leg lengthening in an animal model. The growth rate of the physis, histomorphological changes in the physis and cellular activity in the growth plate were studied. An osteotomy without lengthening, consistently produced stimulation of growth in the physis. No appreciable changes were observed in the physis in limbs lengthened upto 20%. When lengthening in excess of 30% was undertaken, physeal growth was drastically reduced and in 50% of the cases there was evidence of premature closure of the distal growth plate.

EDITORIAL COMMENT

This experimental study on a small group of animals shows that limb lengthening in excess of 30 % does have a deliterious effect on the growth plate. While we may not be able to extrapolate from the study, the exact degree of lengthening in children that may cause premature physeal arrest, the observation of this study does have clinical relevance. As the authors rightly point out "caution should be exercised while carrying out high percentage of limb lengthening in children". In the light of these observations it may be appropriate to suggest that in situations where lengthening in excess of 30% is required, staged lengthening be done, or lengthening should be deferred till close to skeletal maturity.

4. Progressive slippage after pinning for Slipped Capital Femoral Epiphysis. *Sanders JO, Smith WJ, Stanley EA et al.* Shriners Hospital for Children, Erie, Pennsylvania and Santa Rosa Children's Hospital, San Antonio,Texas, USA. *Journal of Pediatric Orthopaedics 2002;22:239-43.*

The authors identified seven cases of progressive slipped capital femoral epiphysis after screw fixation. Two patients had an underlying endocrinopathy. Five patients had an acute on chronic slip. All the children had been operated by percutaneous in-situ fixation with one or two screws. Despite optimal placement of screws, progressive slippage occurred. The characteristic feature in all cases was the persistence of symptoms post-operatively. Progression of the slip was noted on an average after five months. In all seven cases, the purchase of the screw in the epiphysis remained secure, but loss of purchase in the femoral neck occurred. The authors conclude by emphasizing that children with slipped capital femoral epiphysis in whom 1) there is an associated endocrine disorder 2) the slip is unstable 3) symptoms persist even after fixation, should be closely monitored to identify slip progression early.

EDITORIAL COMMENT

The authors have defined the features that help to identify chil-

dren prone to progression of slipped capital femoral epiphysis. This complication is quite troublesome and the long term prognosis in these patients can be poor if the complication is not recognised early and dealt with. Among the three features identified by the authors it is possible that the first two may remain unrecognised. Unless routine endocrinological work-up is done the endocrinopathy may not be identified. Facilities for endocrine evaluation may not be available in many centres. Similarly, the fact that one is dealing with an unstable slip may occasionally be overlooked. However, the feature that is likely to be most useful is "persistence of symptoms after adequate fixation of the slip". Any child who demonstrates this feature should be monitored with sequential radiographs over the next six months. Another interesting feature demonstrated in this study was that the loss of fixation was *not* in the epiphysis but in the femoral neck. In view of this, it may also be worth enforcing non-weight bearing in children with persistence of pain following fixation of slipped capital femoral epiphysis.

5. Three weeks of Kirschner wire fixation for displaced lateral condylar fractures of the humerus in children.

Thomas DP, Howard AW, Cole WG, Hedden DM. Hospital for Sick Children, Toronto, Canada. *Journal of Pediatric Orthopaedics 2001;21:565-9.*

The study was undertaken to determine whether a 3 week period of K-wire fixation and plaster cast immobilisation was sufficient for achieving union of displaced lateral condylar fractures of the humerus. Over a 7-year period 104 children with displaced lateral condylar fractures were treated by open reduction and K-wire fixation. All these children had the wires removed after 3 weeks. 103 of 104 fractures united.

EDITORIAL COMMENT

This study, involving the largest series of lateral condylar fractures of the humerus reported so far, shows that 3 weeks of K-wire fixation is sufficient to achieve union. The study questions the need for retaining the wires for six weeks as was generally recommended in the past.

6. Tibial lengthening: Does the fibula migrate?

Saleh M, Bashir HM, Farhan MJ, McAndrew AR, Street R.. Sheffield Children's Hospital, Sheffield, UK. *Journal of Pediatric Orthopaedics B 2002;11:302-6*

In this retrospective study, the effect of limb lengthening on the position of the lateral malleolus was studied. In 16 patients the fibula was fixed to the tibia prior to lengthening, while in 16 patients no such fibular stabilisation was performed. The position of the fibula, after completion of lengthening, was assessed by four separate radiological measurements. In all 32 patients, proximal migration of the fibula occurred, but the extent of proximal migration was significantly higher and the frequency of valgus deformity of the ankle was greater in patients in whom fibular stabilisation was not performed. The study confirmed the need for fibular fixation.

EDITORIAL COMMENT

This simple study emphasises the need for stabilising the fibula prior to commencement of tibial lengthening. This procedure, in addition to excising a 1 - 1.5 cm segment of the fibula, can reduce the frequency of valgus deformity of the ankle following tibial lengthening.

7. Hip surveillance in children with cerebral palsy.

Dobson F, Boyd RN, Parrott J, Nattrass GR, Graham HK. Royal Children's Hospital, Melbourne, Australia. *Journal of Bone & Joint Surgery [Br]2002;84-B:720-6.*

The authors studied the impact of a hip surveillance clinic on the type of surgery undertaken to either prevent or treat hip instability. The surgical procedures performed were classified as: preventive (soft tissue surgery), reconstructive (redirectional osteotomies of the femur or pelvis) and salvage procedures. Following the establishment of the hip surveillance clinic, the frequency of preventive surgery increased, the need for reconstructive surgery decreased and the need for salvage surgery was eliminated. Based on their experience, the authors recommend that hip survellance should become part of the routine management of cerebral palsy. They suggest that all children should have radiographs of the pelvis at 18 months of age and at 12-monthly intervals thereafter.

EDITORIAL COMMENT

The paper highlights the importance of screening for early hip subluxation in children with cerebral palsy. There is no doubt that if such a screening programme can minimise the need for bony surgery and more importantly, eliminate the need for salvage surgery (like proximal femoral excision) it would be invaluable. Anyone involved with management of children with cerebral palsy should take note of this paper. We should make it a point to examine the hips of these children regularly and obtain radiographs of the pelvis at least once a year in order to diagnose subluxation of the hips early enough to correct it by soft tissue surgery alone.

8. Congenital pseudarthrosis of the tibia. Results of technical variations in the Charnley-Williams procedure.

Johnston CE II. Texas Scottish Rite Hospital for Children, Dallas, Texas, USA. *Journal of Bone & Joint Surgery [Am]2002;84-A:1800-10.*

The results of treatment of 23 consecutive cases of congenital pseudarthrosis of the tibia who underwent different modifications of the Charnley-Williams method of intramedullary fixation and bone grafting were analysed. The three modifications related to how the fibula was handled. In one modification, the fibula was fixed with an intramedullary rod; in the second modification osteotomy or resection of the fibula was done; in third modification no fibular surgery was undertaken. The results were poor when the fibula was not operated. The authors strongly recommend that the fibula must be fixed and grafted if there is an associated fracture of the fibula in patients with congenital pseudarthrosis of the tibia.

ARTICLES PUBLISHED BY MEMBERS OF POSI

Plain radiographic evaluation of mid-tarsal malalignment in clubfoot. *Bhatia M, Joseph B.* Kasturba Medical College, Manipal. *The Foot 2002;12:63-9*

Grebe syndrome with bilateral fibular hemimelia and thumb duplication. *Rao N, Joseph B.* Kasturba Medical College, Manipal. *Skeletal Radiology 2002 ;31:183-7.*

The authors would be pleased to send copies of their articles to any member who requests them.

Invited REVIEW

DIAGNOSIS AND MANAGEMENT OF ACUTE COMPARTMENT SYNDROME IN CHILDREN

Acute compartment syndrome is a surgical emergency characterized by elevated tissue pressure in an osteofascial compartment of a limb. Persistent elevation of the tissue pressure can compromise capillary perfusion and this, in turn, can result in irreversible damage to the muscles and nerves within the compartment. Early diagnosis and prompt decompression of the compartment by a fasciotomy is essential in order to prevent these complications.

Diagnosis

a) Clinical diagnosis

A clinical diagnosis of compartment syndrome is made if there is

i) pain out of proportion to the injury,
ii) pain on passive stretching of the muscles of the compartment and
iii) sensory impairment in the area of distribution of the nerves traversing the compartment.

However, none of these symptoms and signs can be elicited in an unconscious patient, and in patients who have had a regional block. Eliciting these signs with any degree of confidence is often difficult in children even if they are fully conscious. It becomes virtually impossible in the crying, non-verbal or obtunded child.

Several text books of orthopaedics teach the eponym of "5 Ps " (pain, pallor, paraesthesia, paralysis and pulselessness) as the diagnostic hallmarks of compartment syndrome. However, it is extremely important to be aware that these signs and symptoms are UNRELIABLE. What is even more important is to realise that if one waits for some of these signs to appear (e.g. pulselessness) irreversible damage to the tissues is likely to have already occurred. Compartment syndrome *must* be diagnosed long before the stage of pulselessness and paralysis. Bae and his colleagues, in a recent article, suggest that restlessness, agitation and anxiety with an increasing analgesia requirement may be indicators of an impending compartment syndrome in children (1).

b) Confirmatory tests

Confirmation of the diagnosis of compartment syndrome currently entails direct recording of the tissue pressure by invasive means. Different techniques of invasive recording of intra-compartmental pressure have been described in the literature (2-5). Since compartment syndrome is a progressive phenomenon, a single recording of normal compartment pressure at one point of time does not imply that all is well. Tissue pressure can build up gradually and rise to unacceptable limits. Consequently it may be necessary to monitor intra-compartmental pressures sequentially (4). This can be done by repeated measurements involving skin punctures on each occasion or by leaving an in-dwelling catheter till the clinical situation warrants it. Both these options have obvious disadvantages.

It would, therefore, be very useful if a method of measuring compartment pressures non-invasively could be devised. Steinberg and Gelberman (6) reported an experimental study where they measured the quantitative hardness of the limb as a method of diagnosing compartment syndrome. Their device was based on the principle of the indentation technique used for measurement of hardness of materials. Similar techniques have been used for a long time now for measuring intra-ocular pressure. One would hope that a device similar to a tonometer used in ophthalmology would be invented in the near future. It is heartening that such efforts are currently under way in India. Such a device would be invaluable in pediatric orthopaedic practice.

Management

There is no consensus on the absolute value of intra-compartmental pressure that is accepted as the critical value for considering decompression. Some surgeons would consider a fasciotomy for pressures exceeding 30mm Hg, while others may wait till a pressure of 40mm Hg is reached before performing a fasciotomy. The difference between diastolic blood pressure and the intra-compartmental pressure is now considered to be a more sensitive indicator of tissue perfusion within the compartment than the absolute value of intra-compartmental pressure. If this difference is less than 30mm Hg, a fasciotomy is considered to be mandatory (7).

Effective decompression of the involved compartment can be achieved by a fasciotomy. Although this is not disputed, there is no agreement as to whether a fasciotomy should be combined with an epimysiotomy recommended by Eaton and Green (8). Most surgeons would stop short at a fasciotomy. Despite the problems associated with long skin incisions, open fasciotomy through a skin incision extending over the entire length of the forearm or leg is the most reliable method of decompressing the compartments adequately. The skin must be left unsutured after the decompression. Limited fasciotomy or a subcutaneous fasciotomy is avoided because complete decompression of the fascial envelopes cannot be assured through small incisions. The rationale of leaving the skin unsutured is that the skin, if

sutured, could well become the limiting boundary of the compartment leading to increase in the compartment pressure yet again when post-ischaemic hyperaemia and swelling occur after the fasciotomy (9). After decompressing the compartments ,viability of the muscles within each compartment is carefully assessed and all non-viable tissue is radically excised.

Fasciotomy for compartment syndrome of the forearm:

While the volar compartment of the forearm is most commonly involved, a compartment syndrome can develop in the dorsal compartment also. It has been demonstrated that a volar fasciotomy effectively decompresses both volar and dorsal compartments in most instances (10). A dorsal fasciotomy may be reserved for the rare instance where the dorsal compartment continues to remain tense after a volar fasciotomy.

The incision for a volar fasciotomy should extend from the elbow to the palm and should be placed so as to have access to both the median and ulnar nerves and the brachial artery (10). A carpal tunnel release may also be performed at the same time if features of a median neuropathy are present. This has been shown to occur occasionally with distal radial fractures in children (11).

Fasciotomy for compartment syndrome of the leg:

Some surgeons would attempt decompression of the leg through one single lateral incision. However, a two incision technique is currently recommended (7). The superficial and deep posterior compartments are decompressed through a medial longitudinal incision placed 1 to 2 cm posterior to the medial border of the tibia. The second longitudinal incision is placed 2 cm lateral to the anterior tibial border, through which the anterior and peroneal compartments are decompressed. Accurate placement of these incisions is important. An incision inadvertently placed directly over either the tibia or fibula may expose the bone. Care should be taken also to avoid exposing tendons in the distal third of the leg. Exposure of the bone or tendons increases the risk of delayed healing and infection (7).

Management of fasciotomy wounds

Management of the fasciotomy wound is controversial. Wound complications appear to be far more frequent following primary or delayed primary closure of the wounds as compared to split skin grafting. Johnson *et al* (12) noted wound complications in 51% of patients who underwent primary or delayed primary closure while only 5% of patients who had split skin grafts had wound complications.

Conclusion

Compartment syndrome in children remains a challenge, but serious permanent disability can be prevented. With early diagnosis and prompt decompression, full restoration of function can be achieved in > 90% of children who develop a compartment syndrome (1).

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DEBATE Lengthening of the Achilles tendon *versus* selective lengthening of the gastrocnemius for spastic equinus in cerebral palsy

Equinus deformity is one of the commonest problems encountered in children with cerebral palsy. Spasticity, contracture, or a combination of spasticity and contracture of the triceps surae lead to this deformity. The roles the gastrocnemius and the soleus play in causing the deformity differ. The gastrocnemius, which is a biarticular muscle, tends to develop more spasticity than the monoarticular soleus. This is in keeping with the impression that cerebral palsy appears to primarily affect biarticular muscles while the function of single joint muscles are less severely affected (1).

There is general agreement that dynamic equinus due to pure spasticity should be treated by conservative methods, which include physical therapy, tone-inhibiting casts, myo-neural blocks and orthoses. Surgery is reserved for patients with established myostatic contractures of the triceps surae. Among the surgical options that have been described for correction of equinus deformity in cerebral palsy are neurectomy of the gastrosoleus, gastrocnemius lengthening, recession of the origin of the gastrocnemius, achilles tendon lengthening and achilles tendon translocation. Neurectomy is no longer popular as it merely paralyses muscle but does not lengthen it (2). Similarly, recession of the origin of the gastrocnemius and achilles tendon translocation are seldom done now (2). Currently, most surgeons would opt for either gastrocnemius lengthening or achilles tendon lengthening.

Gastrocnemius lengthening was initially done by Vulpius and Stoffel in the early 20th century. The procedure was modified by Strayer and then by Baker in the 1950's. The popularity of this technique waned in the 1980's (2), but of late, the pendulum appears to be swinging in favour of this procedure (3,4,5) The proponents of gastrocnemius lengthening discourage lengthening of the achilles tendon based on the impression that the latter procedure can compromise the efficiency of gait. However, several surgeons continue to perform achilles tendon lengthening. Which of these procedures should we choose? To help us to make an informed choice let us first consider the function of the triceps surae and what the effects of weakness or overactivity of the muscle are.

The function of the triceps surae

While standing: The triceps surae facilitates maintenance of the upright posture by virtue of it being an antigravity muscle.

While walking: The function of the triceps surae is more complex during the gait cycle. In mid stance, *eccentric contraction* of the triceps surae decelerates forward tibial rotation about the talus. In other words, it merely resists rapid dorsiflexion. In terminal stance, *concentric contraction* of the muscle enables the "push off". Here the muscle produces active plantarflexion.

The effect of paralysis of the triceps surae

Quite striking changes in the gait pattern occur when the triceps surae is paralysed. Excessive dorsiflexion occurs during mid-stance, there is no effective push off, the stride length and the gait velocity are reduced and there is significant increase in energy expenditure.

The effect of spastic equinus

In children with spastic equinus, stance phase stability is poor, there is loss of smooth movement of the body over the foot in mid stance and poor foot clearance during the swing phase. The child has to vault over the plantarflexed foot. This increases the vertical oscillation of the centre of gravity resulting in excessive energy expenditure.

What is the desired "optimal" outcome of surgery for spastic equinus in cerebral palsy?

It is evident that ***both*** weakness of the triceps surae *and* spastic overactivity of the muscle, with resultant equinus, are undesirable. It follows that any surgery for spastic equinus should attempt to overcome the spasticity and myostatic contracture sufficiently without producing demonstrable weakness of plantarflexion of the ankle. One of the problems of achieving this aim is that ***all*** surgical methods of dealing with equinus entail weakening of the muscle. Irrespective of whether the gastrocnemius or the achilles tendon is lengthened, some weakness of plantarflexion will occur as both procedures reduce the resting length of muscle fibres.

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NEWS AND NOTES

FELLOWSHIP IN PAEDIATRIC ORTHOPAEDICS

The Paediatric Orthopaedic Service of the Department of Orthopaedics at Kasturba Medical College has been recognised by the **National Board of Examinations** for a **two year** Post-doctoral Fellowship in Paediatric Orthopaedics. The Fellowship offers an exposure to a broad range of Paediatric Orthopaedic diseases. The National Board would award a certificate on completion of the Fellowship.

For further information contact : Dr.Benjamin Joseph, Paediatric Orthopaedic Service, Department of Orthopaedics, Kasturba Hospital, Manipal 576 119. Notification by the National Board for the next session would appear in national newspapers. Applications would have to be submitted to the National Board of Examinations.

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Dr.Benjamin Joseph,
Department of Orthopaedics
Kasturba Medical College & Hospital
MANIPAL 576 119, Karnataka State

Editors:
Dr. Benjamin Joseph
Dr. Ashok Johari