POSITIVE

OFFICIAL NEWSLETTER OF
THE PAEDIATRIC ORTHOPAEDIC
SOCIETY OF INDIA

A TIME FOR CHANGE

POSITIVE is now ten years old! Over the last decade, one or two issues of POSITIVE have been published annually. The prime aim of the publication has been to convey information regarding important issues related to our speciality to our members. The Editors were aware that very few of our members have access to the two Journals of Pediatric Orthopaedics. An effort was made to select articles of common interest from these and other Journals and present abstracts of these articles along with a short editorial comment. Invited brief reviews of selected topics and discussions of controversies in paediatric orthopaedics were other features of the publication.

We hope that the aim of conveying information to the members has been fulfilled in some measure. On our part we have certainly learnt a great deal in the process and have enjoyed preparing each issue. The entire typesetting and formatting and page layout was done in-house and so any typographical or spelling errors were our own!

As the primary aim of the Newsletter was to facilitate education we felt that it is not important to emphasize the names of contributors and so names of contributors did not appear prominently in any issue. We thank those who did contribute with relative anonymity.

As the two new Editors, Dr. Alaric Aroojis and Dr. S.S. Gill take charge, we hope that they will find new exciting ways of keeping the members updated on the developments in the fascinating field of paediatric orthopaedics. We wish them well and we eagerly look forward to future issues of POSITIVE.

Mar.
2005

**POSI TRANSFERS
INFORMATION VERY
EFFECTIVELY**

ABSTRACTS

Contents

1. Complications of elastic stable intramedullary nail fixation of pediatric femoral fractures, and how to avoid them. *Narayanan UG, Hyman JE, Wainwright AM, Rang M, Alman BA.* The Hospital for Sick Children, Toronto, Canada. *Journal of Pediatric Orthopaedics 2004; 24:363-369.*

The authors report the results of titanium elastic intramedullary nailing of paediatric femoral fractures in 78 chidren with special emphasis on the complications encountered and recommendations on how to avoid them. The complications included loss of reduction, pain at the insertion sites, malunion, refracture, transient neurological deficit and superficial wound infection. While most of the complications were minor and preventable, ten patients required repeat surgery prior to union. Loss of reduction was associated with use of nails of mis-matched diameters and cortical comminution of more than 25%. The authors advocate advancing the nail ends to lie against the supracondylar flare of the femur to avoid irritation at the insertion site. They also suggest that use of nails of varying diameter should be avoided and recommend the use of additional external immobilisation in case of comminution.

EDITORIAL COMMENT

The authors report the complications they encountered in their initial five-year experience of elastic nailing of femoral fractures. They suggest useful suggestions on how to avoid some of these complications. This is valuable information that will come in handy as more and more surgeons adopt this method of treatment for femoral fractures in children.

2. The influence of treatment on the pathology of clubfoot. CT study at maturity. *Ippolito E, Fraracci L, Farsetti P, Di Mario M, Caterini R.* University of Rome, 'Tor Vergata', Rome, Italy. *J. Bone Joint Surg 2004, 86-B : 574-80.*

The authors performed a CT study to investigate how treatment may modify the skeletal pathology of congenital clubfoot. Two groups of patients were studied. The first group of 32 patients (47 feet) treated by manipulation, cast application and an extensive posteromedial soft tissue release were reviewed at a mean age of 25 years. The second group of 32 patients (49 feet) treated by the Ponseti technique of serial manipulation, cast application and limited posterior release were reviewed at a mean age of 19 years. The CT study at maturity showed that the shape of the sub-talar, talonavicular and calcaneocuboid joints was altered in many feet in both groups. This did not appear to be influenced by the type of treatment. Reduction of the medial subluxation of the navicular on the talus was better in the first group whereas correction of heel varus and declination angle of the neck of the talus was better in the second group.

EDITORIAL COMMENT

The authors attempt to analyze how treatment alters the pathoanatomy of clubfoot. While they show that treatment does alter the structure of the foot, no strong conclusions can be drawn about the superiority of one form of treatment over the other. *What is humbling is that irrespective of the nature of treatment no foot was perfectly normal*!

3. Ischaemic necrosis following clubfoot surgery: the purple hallux sign. *Hootnick DR, Packard Jr DS, Levinsohn EM, Berkowitz SA, Aronsson DD, Crider Jr RJ.* State University of New York, Syracuse, New York, USA. *Journal of Pediatric Orthopaedics B 2004;13:315-322.*

The authors report massive ischaemic necrosis in 7 limbs of 6 patients following clubfoot surgery. They also reviewed another 7 similar cases reported in the literature previously. Substantial hypoplasia of the profunda femoris and posterior and anteror tibial arteries was demonstrated by arteriography in one patient in this series. The authors believe that necrosis occurs in those regions supplied by congenitally diminished anteror tibial and dorsalis pedis arteries and advocate early detection of ischaemia to prevent or ameliorate the consequences of this complication.

EDITORIAL COMMENT

The authors draw attention to a dreaded complication of clubfoot treatment. We should take careful note of this report. *The seriousness of this complication (sometimes warranting an amputation) influenced the Editor to make a more detailed commentary on this problem in this issue of POSITIVE.*

4. Reliability of radiographic assessment of distraction osteogenesis site. *Starr KA, Fillman R, Raney EM.* Shriners Hospital for Sick Children, Honolulu, Hawaii, USA. *Journal of Pediatric Orthopaedics 2004;24:26-29.*

The authors evaluated the reliability of radiographic assessment of bony healing of distraction osteogenesis. 42 radiographs of consolidating distraction gaps were reviewed by nine examiners on two different occasions for presence of number of cortices and timing of fixator removal. The kappa coefficients of intraobserver and interobserver reproducibility for number of cortices and fixator removal were 0.13 & 0.29 and 0.35 & 0.46 respectively. These values indicate poor reliability in radiographic assessment of number of cortices and moderate reliabilty for removal of fixator. The examiners had used criteria other than number of cortices for deciding fixator removal.

EDITORIAL COMMENT

Those involved in limb lengthening would acknowledge that it is often difficult to decide when to remove the fixator. Premature removal may result in bowing or fracture of the regenerate. It has been recommended that if three cortices have reformed (as judged from the anteroposterior and lateral radiographs) the fixator may be removed. This study shows that plain radiographic evaluation of reformation of the cortices is unreliable. We do need to have more reproducible methods of evaluating the consolidation of the regenerate to enable decision-making for fixator removal.

5. The static examination of children and young adults with cerebral palsy in the gait anlysis laboratory: technique and observer agreement. *Keenan WN, Rodda J, Wolfe R, Roberts S, Borton DC, Graham H K.* Royal Children's Hospital, Victoria, Australia. *Journal of Pediatric Orthopaedics B 2004;13:1-8.*

The authors conducted this study in 20 patients to evaluate the reproducibility of five important joint range of motion measurements, used during static examination of children with cerebal palsy. These included the Thomas' test, the range of knee extension, the popliteal angle and the ranges of ankle dorisflexion with the knee flexed and extended. There was considerable variation in inter-observer agreement in measuring joint motion. However, by taking a $\pm$ 10 degree margin of error as a clinically acceptable level of variation, acceptable levels of intra-observer and inter-observer agreement were noted for most variables. The popliteal angle and the range of ankle dorsiflexion with the knee flexed had only borderline reproducibility.

EDITORIAL COMMENT

The particular relevance of this study is that the vast majority of clinicians involved in the management of children with cerebral palsy rely on clinical assessment of the ranges of movements at the hip, knee and ankle for decision making for interventions in these children. It is gratifying to note that these measurements are reasonably reproducible. (The authors arbitrarily chose a 10 degree margin of error to be within limits of acceptability in clinical practice. This would seem to be a very reasonable margin of error while measuring joint movements.)

6. Extra-articular sub-talar arthrodesis. A long term follow-up in patients with cerebral palsy. *Bourelle S, Cottalorda J, Gautheron V, Chavrier Y.* Medical School of Medicine, Saint-Etienne, France. *Journal of Bone and Joint Surgery 2004; 86-B: 737-742.*

Grice extra-articular arthrodesis for valgus hindfeet was performed on 36 feet of 23 ambulant cerebral palsy patients. 17 of these patients (26 feet) were reviewed 20 years after surgery. 13 patients were pleased with the results, 13 had no pain and 15 were still able to walk. The overall clinical results were satisfactory. Radiological assessment showed that 14 feet had developed a mean ankle valgus of 11degrees with compensatory hindfoot varus in 12 feet. No arthritis was noted in the adjacent joints. The authors conclude that long-term results of this procedure are good.

EDITORIAL COMMENT

The paper reports the long-term outcome of one way of dealing with a valgus hind foot in cerebral palsy. While the results are, indeed, quite encouraging it needs to be emphasized that if we can correct the valgus deformity without having to fuse any joint it would certainly be better. Early release of a tight tendo Achilles and weakening of spastic peronei in the younger child and calcaneal lengthening in the older child should be considered before fusing the subtalar joint.

7. Neonatal brachial plexus palsy: outcome of absent biceps funtion at three months of age. *Smith NC, Rowan P, Benson LJ, Ezaki M, Carter P R.* Texas Scottish Rite Hospital, Dallas, Texas, USA. *Journal of Bone and Joint Surgery 2004;86:2163- 2170.*

This prospective study assessed the long-term outcome of 28 infants with neonatal obstetric brachial plexus palsy *who had no recovery of the biceps muscle at three months of age*. The level of injury was C5-C6 in 46%, C5-C7 in 18% and C5-T1 in 36% of the patients. After a mean follow-up period of 11 years, function was assessed by the modified Mallet score and by manual muscle testing. Recovery in biceps function was observed by six months of age in twenty patients (70%) and this group included all the patients with C5-C6 injury. Patients who regained biceps muscle function between 3 to 6 months of age had overall better abduction, hand to neck and hand to back function than patients who who regained biceps function after 6 months. Patients with a C5-C6 lesion had better functional scores for external rotation, hand to neck, hand to mouth and hand to back function than did patients with a panplexus lesion. 27 of the 28 patients had at least Grade III power of elbow flexion at follow-up.The authors conclude that prolonged neurological recovery of biceps and a more extensive level of injury was associated with poorer long term shoulder funtion. Patients with a C5-C6 injury and absent biceps recovery at 3 months of age often have good long-term shoulder function without brachial plexus surgery.

EDITORIAL COMMENT

The results of this study challenge the recent trend to consider exploration of the brachial plexus in all children who do not show recovery of active elbow flexion by three months of age (*See* Invited Review *"What should be done for obstetric brachial plexus injuries?"* ***POSITIVE*** Dec 2003). These authors show that if elbow flexion was regained by 6 months of age the function may be quite good. In the light of this report, it may be acceptable to wait till six months of age to see if elbow function recovers before embarking on brachial plexus exploration particularly so in infants with C5-C6 lesions.

ARTICLES PUBLISHED BY MEMBERS OF POSI

Connecting bar for hip spica reinforcement: does it help? *Rebello G, Joseph B, Chincholkar.* Kasturba Medical College, Manipal. *Journal of Pediatric Orthopaedics-B 2004;13.345-6.*

How does a femoral varus osteotomy alter the natural evolution of Perthes' disease. *Joseph B, Rao NKL, Mulpuri K, Varghese G, Nair NS.* Kasturba Medical College, Manipal. *Journal of Pediatric Orthopaedics-B 2005;14.10-15.*

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

Invited REVIEW

OUTCOME EVALUATION OF CLUBFOOT TREATMENT

It is interesting to note that while there are innumerable articles on different treatment modalities for clubfoot, there are less than 60 studies that have attempted to report outcome results using validated and standardized instruments[3,5]. Historically, the literature on clubfoot outcomes have focused on traditional "intermediate end-points" such as physician-based assessments of morphology by clinical and radiographic methods, with little emphasis on patient-based information such as cosmesis and function. Numerous grading systems have been proposed, with the majority of the reports expressing outcome in terms of an "excellent, good, poor" results. Although the difficulty in creating such systems has been acknowledged, none of these grading systems has undergone any attempt at validation. Nevertheless, there are a handful of outcome evaluation systems that merit attention[2,4,6,7,8]. Broadly speaking, outcome evaluation systems are of two types:

- Physician-based evaluation
- Patient-based evaluation

Physician-based Evaluation Systems: Bensahel[2], Magone[6] and MacKay[7] reported objective methods of measuring treatment outcome based on assessment of morphology and radiographs. They devised scoring systems that attempted to measure outcome objectively in the traditional domains of morphology, range of motion, muscle strength and radiographic measurements. However, point allocation for different items in these grading systems is completely empiric rather than statistically derived, and this remains a major weakness. Radiographs have also been shown to be unreliable in predicting or reflecting outcome, as the uniplanar projections attempt to define a complex three-dimensional rotational deformity. Nevertheless, the advantage of these systems lies in their objectivity.

Patient-based Evaluation Systems: Another important aspect of outcome assessment involves the use of patient-based measures such as functional status, cosmesis, pain and quality of life issues. Laaveg and Ponseti[4] designed a rating system for functional results with 100 points indicating a normal foot. Points were allotted in the domains of patient satisfaction (20 points), functional activities (20 points), presence or absence of pain (30 points), gait (10 points), heel morphology (10 points) and range of motion (10 points). Thus 70% of point weightage was allocated to subjective assessments, which can introduce a huge margin of bias and error. Roye et al[8] have more recently attempted to reduce the element of bias and subjectivity by introducing a disease-specific instrument in the domains of patient satisfaction and function. However the challenge lies in developing a valid and reliable instrument that is sensitive enough to detect subtle perception of functional impairment.

The International Clubfoot Study Group (ICFSG): In an attempt to clear some of the confusion surrounding clubfoot and in order to establish a uniform, valid and reliable system of evaluation, the International Clubfoot Study Group was founded by Prof Henri Bensahel (France), Dr. Ken Kuo (USA, Taiwan) and Dr. Morris Duhaime (Canada) in 1995. The ultimate aim of the Study Group is to establish ***a common language for clubfoot assessment*** using objective criteria which are internationally accepted.

The ICFSG Outcome Evaluation System: Realizing the need to establish an internationally uniform language for clubfoot, the ICFSG has formulated an Outcome Evaluation System to objectively compare the results of clubfoot treatment[1]. The highlights of the system are to combine physician and patient-based criteria that would include morphology and function. Outcome is measured in three finite domains of morphology, functional assessment and radiographic evaluation. Maximum weightage of points is assigned to functional assessment (36 points), while 12 points each are assigned to morphology and radiographic evaluation, for a total score of 60 points. Functional evaluation is sub-divided into assessment of passive joint motion, muscle function, gait and presence of pain as shown overleaf.

Indian Chapter of the ICFSG: It is proposed to start an Indian chapter of the International Clubfoot Study Group under the aegis of POSI and the ICFSG. We do see a large number of clubfeet in the Indian subcontinent especially neglected and relapsed cases. There appears to be a wide range of treatment options available including serial manipulation and casting, soft-tissue releases and use of external fixators such as Ilizarov and JESS. Can we establish a consensus of opinion on the optimum treatment of clubfoot? As leaders in paediatric orthopaedic care, the onus is ***on us*** to establish uniform protocols of evaluation and treatment that can be emulated by the general orthopaedists. The objectives of the Indian Clubfoot Study Group would be:

- To devise a uniformly acceptable outcome evaluation system based on the ICFSG criteria that would yet be relevant to our setting.
- To devise an objective assessment system for pre-treatment evaluation of clubfeet.
- To document results of our treatment by various modalities (Ponseti casting, soft-tissue releases, external fixators etc) using valid and reproducible criteria.
- To conduct multi-center studies on various aspects of clubfoot etiology, epidemiology and treatment.

Indeed, it is time to pool together data from various institutions, so that a large and meaningful database can be established that will help us in formulating treatment guidelines and protocols most suitable for India.

POSI members desirous of becoming members of the Indian Chapter of the ICFSG may contact Dr. Alaric Aroojis

The ICFSG Outcome Evaluation System

MORPHOLOGY: **SCORE**

A. Hindfoot:			
1. Varus or Valgus	0	1 (10°)	2 (>10°)
2. Equinus or Calcaneus	0	1 (10°)	2 (>10°)
B. Midfoot:			
1. Supination or Pronation	0	1 (10°)	2 (>10°)
2. Adduction or Abduction	0	1 (10°)	2 (>10°)
C. Global alignment of the foot:			
1. Rotation: Medial / Lateral (Thigh-Knee foot angle)	0	1 (10°)	2 (>10°)
2. Pes cavus or Flatfoot	0	1 (10°)	2 (>10°)

Maximum Score for Morphology 12

FUNCTIONAL EVALUATION **SCORE**

A.Passive Motion:

1. *Ankle motion*

a. Dorsiflexion (in degrees)	0	1 (0°)	2 (negative)
b. Plantarflexion (in degrees)	0	1 (10°)	2 (negative)

2. *Subtalar motion*

a. Varus - Valgus:	0 (flexible)	1 (stiff)

3. *Midtarsal motion*:

a. Pronation-supination:	0 (flexible)	1 (stiff)

B. Muscle Function:

	Normal	*Moderate*	*Severe*
Jones' classification (MRC)	(5,4)	(3)	(2,1,0)
1. Triceps surae	0	1	2
2. Toe flexors FDL	0	1	2
3. Toe extensors EDL	0	1	2
4. Anterior tibial	0	1	2
5. Posterior tibial	0	1	2
6. Peronei	0	1	2
7. EHL	0	1	2
8. FHL	0	1	2

C. Dynamic Function:

1. *Gait*	None	Positive	
a. Intoeing (medial rotation)	0	1 (10°)	2 (>10°)
b. Calcaneus or equinus	0	1 (10°)	2 (>10°)
c. Dynamic supination	0	1 (10°)	2 (>10°)
d. Limping	0	1	
e. Ability to run	1	0	
f. Ability to jump	1	0	
2. *Shoe wear*	0 (Normal)		1 (Abnormal)
3. *Heel walking or Toe walking*	0 (Yes)		1 (No)

FUNCTIONAL EVALUATION Contd

D. Pain:

1. No pain	0
2. Pain with activity	1
3. Pain with sports	2
4. Constant	3

Maximum Score for Functional Evaluation 36

RADIOLOGICAL EVALUATION

A. Standing AP Views (foot in weight bearing position)

	Normal	Abnormal
1. Talo-calcaneal angle	0	1
2. Cuboid-calcaneo alignment	0	1
3. Cubo-M5 axis	0	1
4. Talo-M1 angle	0	1
5. Talo-navicular position	0	1

B. Standing Lateral Views (foot in weight bearing position)

	Normal	Abnormal
1. Talo-calcaneal angle	0	1
2. Tibio-calcaneal angle	0	1
3. Talo-navicular position	0	1
4. Talo-M1 axis	0	1
5. Calcaneo-M5 angle	0	1
6. Flat top talus	0	1

C. Ankle AP Standing

Normal	Abnormal
0	1

Maximum Score for Radiological Evaluation 12

Total Score: 0 = Perfect Result, 60 = Worst Result

Classification of Results

Very Good	**Total score: 0 to 5**
Good	**Total score: 6 to 15**
Fair	**Total score: 16 to 30**
Poor	**Total score: >30**

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Commentary

Ischaemic necrosis after surgery for clubfoot

Dr. Hootnick has, through a series of publications, drawn attention to one of the most disastrous complications of clubfoot surgery; namely ischaemic necrosis. In the recent article published in the JPO-B last year, 14 instances of this complication were described (1). Of these fourteen feet, eight had to be amputated!

On the basis of angiographic studies several investigators have shown that in a proportion of children with clubfeet, there may be anomalies of arteries (2-8). In particular, the anterior tibial vessels and the dorsalis pedis artery may be hypolastic or deficient. What is particularly alarming is that these anomalies were demonstrable in as many as 90% of limbs with clubfeet that underwent angiographic evaluation. This suggests that vascular abnormalities are very frequent in clubfeet. The foot in these instances would depend predominantly on the blood supply from the posterior tibial vessels and any injury or insult to the posterior tibial vesels could lead to this catastrophic complication.

A closer look at the cases that had this complication shows that there was no pattern that would enable one to identify cases at risk; almost equal proportion of the children had idiopathic and neurogenic clubfeet, comparable numbers of children were operated before 18 months of age and after 18 months and there were almost equal numbers of boys and girls. There was nothing to suggest that a particular form of surgery was more prone to this complication. In short, any child with clubfoot undergoing surgery at any age could develop this complication. This clearly tells us that we need to be vigilant and look out for this complication whenever we operate on clubfeet.

Hootnick and his colleagues suggest steps to minimize the risk of this complication and I have reproduced them here.

Routine pre-operative procedures

1. Palpate pedal pulses
2. Use halluceal oximetry with the foot in dorsiflexed position and with the Allen test for the foot
3. Correct anemia, be aware of potential complication of hemoglobinopathies or vasculopathies
4. Obtain appropriate informed consent concerning possible ischaemic complications

Routine intra-operative procedures

1. If possible avoid simultaneous operations
2. Carefully release all tethered portions of the neurovascular bundle
3. Release the tourniquet before closure of the wound
4. Palpate the posterior tibial pulse with the foot in the corrected position
5. Check that all the toes become pink within 30 seconds after release of the tourniquet
6. Preserve perioperative normothermia

Routine post-operative procedures

1. Keep the child overnight in hospital (i.e. do not discharge the child on the same day of surgery)
2. Obtain halluceal oximetry prior to discharge
3. Do not depend on capillary return for clinical evidence of adequate perfusion

It is worth noting that apart from the use of pulse oxymetry every other precaution listed above can be followed in every single hospital in India. In addition to these measures, I personally would advocate the following precautions:
1. Immobilize the foot in some degree of under-correction after surgery. Full correction can be achieved after two weeks.
2. Split the plaster cast right ***down to the skin throughout the entire length of the cast*** in the immediate post-operative period. This will ease the constricting effect of the cast that may develop with post-operative oedema. The cast may be completed after 48 to 72 hours.
However, despite all these precautions it is still possible that one may encounter decreased perfusion of the foot. In such a situation characteristically the great toe gets dusky and cyanosed. Hootnick refers to this as the "***purple hallux sign***".

When confronted with acrocynanosis of the great toe or a purple hallux, what should be done? Hootnick makes the following recommendations:

Upon observation of signs of any ischaemia

1. Remove cast or splint in the operating room.
2. Remove K-wires and resume uncorrected position to relieve tension on the posterior tibial artery.
3. Obtain oxymetry of the toes.
4. Open the wound and bathe artery with warm saline or papaverine.
5. Obtain a vascular consultation, consider arteriogram.
6. Repair lacerated arteries, declot or evacuate haematoma.
7. Use vasodilators and anticoagulants till granulation is complete or till oxymetry values are satisfactory.
8. Consider hyperbaric oxygen if available.
9. Immobilize the foot in a splint rather than a cast for better visibility of the foot.
10. REMEMBER, IT IS BETTER TO LOSE CORRECTION THAN TO LOSE THE FOOT

These sound guidelines of steps to be taken if one encounters a "purple hallux" after clubfoot surgery, need to be carefully studied and remembered. However, it needs to be emphasized that while these measures are likely to be of help if the problem is recognized early, delay in diagnosing vascular compromise will result in extensive tissue necrosis. Hootnick has pointed out that the ischaemia may sometimes manifest as late as a week or ten days after surgery, by which time irreversible tissue damage may well have occurred. The most important step in avoiding this catastrophic situation is to diagnose signs of vascular compromise in the operating theatre itself and to institute the remedial measures outlined above immediately. Finally, it is my fervent hope that none of the readers would ever encounter a full-blown vascular catastrophe following clubfoot surgery of the magnitude described in these articles.

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NEWS AND NOTES

FELLOWSHIP IN PAEDIATRIC ORTHOPAEDICS

The Paediatric Orthopaedic Service of the Department of Orthopaedics at Kasturba Medical College offers a **two year** Post-doctoral Fellowship in Paediatric Orthopaedics. The Fellowship offers an exposure to a broad range of Paediatric Orthopaedic diseases. *For further information contact* : Dr.Benjamin Joseph, Paediatric Orthopaedic Service, Department of Orthopaedics, Kasturba Hospital, Manipal 576 104.

ACKNOWLEDGEMENTS

The Editor thanks Dr. Renjit A Varghese, Fellow in Pediatric Orthopaedics at the Kasturba Medical College for his help in the preparation of this issue.

CONTACT ADDRESS OF EDITOR

Comments and suggestions regarding POSITIVE may be sent to the Editor Dr. Alaric Aroojis at alaric_aroojis@hotmail.com

A personal note of thanks

As I hand over the reins of Editorship of this Newsletter, I would like to express my thanks to my colleagues and former Fellows in my Unit who helped me with the preparation of each issue of POSITIVE. I would also place on record the outstanding support I received from **Mr. Vidhyadhar Nayak** of Scanwel, Bangalore, who took such great personal care and interest in the printing of each issue of POSITIVE.

Benjamin Joseph

Published for and on behalf of the Paediatric Orthopaedic Society of India by
Dr.Benjamin Joseph,
Department of Orthopaedics
Kasturba Medical College & Hospital
MANIPAL 576 104, Karnataka State

Editor:
Dr. Benjamin Joseph
Dr.Alaric Aroojis