

**ABSTRACTS FROM BOFSS MEETING Derby November 1998**

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### **THE DIAGNOSTIC AND THERAPEUTIC USES OF FIRST METATARSO-PHALANGEAL JOINT ARTHROSCOPY**

D. Bose, K. Hariharan (Royal Gwent Hospital, Newport, S Wales)

**Introduction:** Arthroscopy of the small joints of the hands and feet has become increasingly popular during the last decade. The first published results of arthroscopy of the first metatarso-phalangeal joint by Bartlett in 1988 has encouraged others in the field of foot surgery to make this procedure a part of their armamentarium.

**Methods:** Five arthroscopies of the first metatarso-phalangeal joint were carried out in four patients. The presenting complaint was pain and stiffness in the great toe following injury in three cases (ages 15 to 21), and pain and stiffness of gradual onset in one (54 year old). Radiographs revealed a Salter-Harris III injury to the proximal phalanx in one case following injury.

**Arthroscopic findings:** Osteochondral fractures were found in two cases, gross degenerative changes in two cases, and an intra-articular fracture of the proximal phalanx (seen on radiographs) in one case.

**Procedures:** Debridement of osteochondral fractures and excision of loose fragments was carried out in two cases, debridement of degenerate joints in two cases and fixation of proximal phalanx fracture under arthroscopic guidance in one case.

**Results:** All patients experienced pain relief following the procedure. Three subsequently regained normal level of activity. One is currently awaiting bilateral joint replacements.

**Conclusion:** Arthroscopy of the first metatarso-phalangeal joint is a valuable diagnostic and therapeutic tool.

### **MORTON'S NEUROMA – A SONOGRAPHIC EVALUATION**

S. Jones, C. Bygrave, R. Betts, T.W.D. Smith (Northern General Hospital, Sheffield, UK)

**Purpose:** To assess the usefulness of ultrasonography in evaluating Morton's neuroma.

**Materials and Methods:** 19 feet in 19 patients with symptoms suggestive of Morton's neuroma were examined using ultrasonography. All of these patients underwent surgical exploration. 3 (16%) of the patients were males and 16 (84%) were females. The age range was 27-61 years with a mean of 45 years.

**Results:** 17 (89%) of the surgically excised masses were confirmed as Morton's neuroma by gross and microscopic pathological examination. 6 (35%) of the neuromas were localised to the 2/3 interspace whilst 11 (65%) were in the 3/4 interspace. The mean diameter using ultrasonography was 6.8 mm (SD 2) whilst that of the surgical specimens was 5.0 mm (SD 3.5). In 13 feet the sonographic diameter was greater than or equal to that of the corresponding surgical specimen. The size correlation was better for surgical specimens greater than 5 mm. In 95% limits of agreement are from -2.9 to 5.9 mm. In addition 14 feet were assessed for Mulder's click pre-operatively. The mean diameter of surgical specimens resected from feet with a positive click was 7.0 mm (SD 3.0) whilst that from feet with a negative click was 4 mm (SD 2.2).

**Conclusion:** Ultrasonography is a useful tool for localising and diagnosing Morton's neuroma. A positive Mulder's click is associated with a larger diameter.

### **TENSION NIGHT SPLINTS FOR THE TREATMENT OF RECALCITRANT HEEL PAIN**

T.E. Kilmartin (Ilkeston Hospital, Derbyshire. UK)

Twenty five patients who had suffered from heel pain for on average 34 months and had unsuccessfully undergone a variety of previous conservative treatment were provided with a

polypropylene night splint which held the foot at 90° to the leg. Symptom relief was measured at 4 weekly intervals using a visual analogue scale while the effect on function was assessed using the American Orthopaedic Foot and Ankle Society Clinical rating system.

Over a three month period visual analogue scores improved in 16 patients, stayed the same in 2 and deteriorated in 7. Functional scores improved in 17 patients, stayed the same in 6 and deteriorated in 2 cases. Ten patients (40%) were discharged pain free after 3 months night splint use while a further 7 (28%) were cured of heel pain within the next three months of night splint use. Eight patients (32%) did not respond to night splint therapy.

Night splints are a safe, effective and relatively inexpensive treatment for heel pain and should be considered as a first line of treatment for the complaint.

### **EXTENSION OSTEOTOMY: A GOOD OPERATION FOR HALLUX RIGIDUS**

R. Rees, R.H. Hartley, A.P.J. Henry (Derbyshire Royal Infirmary, Derby, UK)

Purpose: To evaluate long term results of extension osteotomy as a treatment for hallux rigidus.

Materials and Methods: Clinical and radiographic review of 77 toes was undertaken in 61 patients who had previously undergone extension osteotomy of the hallux. Mean age was 58 years (range 19 – 81) and 74% were female. The length of follow up was 25 to 164 months, with a mean of 81.

Results: In 77% of cases, the patients reported either an excellent or very good result from surgery at the time of follow up, with a good result being reported in a further 14%. Only 8% felt they were the same or worse. 88% of cases had either complete relief of pain at the metatarso-phalangeal joint or mild discomfort at review. The remainder of cases reported residual moderate to severe pain. The mean range of metatarso-phalangeal joint dorsiflexion was 33°. 70% of cases were found on footprint testing to be loading through the first ray.

X-rays showed a progression of arthritic process with 21% of cases showing severe changes pre-operatively compared with 40% at final review. In 9% of cases operation was complicated by superficial wound infection. Three cases required a further operation for disease progression.

Conclusions: We found extension osteotomy provides good results for the treatment of hallux rigidus at medium to long term follow up.

### **ANKLE ARTHRODESIS – A COMPARISON OF OPEN AND ARTHROSCOPIC TECHNIQUES**

A. Taylor, R. Hartley, J. Owen, A.P.J. Henry (Derbyshire Royal Infirmary, Derby, UK)

Introduction: Arthroscopic ankle arthrodesis offers the potential for reducing complications associated with open arthrodesis (infection and delayed or non-union). However, the technical difficulties of the arthroscopic technique may explain the association of an increased risk of non-union by some authors. We compare our early experience of arthroscopic ankle arthrodesis with open arthrodesis.

Method: 30 consecutive patients undergoing ankle arthrodesis (18 open, 12 arthroscopically) were reviewed radiologically and clinically at a minimum 8 months from surgery (range 8 – 36 months). Similar methods of fixation were used in the open and arthroscopic groups – compression with Charnley clamp and large fragment cancellous screws from tibia into the talus.

Results: There was no significant difference in the rate of fusion (88% open, 83% arthroscopic), pain relief (excellent or good – 75% both groups) or mean ankle-hindfoot scores (American Orthopaedic Foot and Ankle Society) (65 in both groups) between the two groups. There were two deep pin site infections in the “arthroscopic” group requiring surgical debridement and intravenous antibiotics. One patient in the “open” group developed deep infection and developed an infected non-union of the ankle despite repeated debridement and antibiotics.

Discussion and Conclusions: Our experience confirms that arthroscopic arthrodesis of the ankle gives comparable rates of successful arthrodesis and is associated with fewer major complications.

### **LESSONS FROM EARLY EXPERIENCE OF THE STAR ANKLE ARTHROPLASTY**

P.H. Cooke (Nuffield Orthopaedic Centre, Oxford, UK)

The notes, operative records and radiographs of the first 20 ankle arthroplasties performed by the author have been reviewed.

18 operations were performed in 16 patients aged 48-76.

Several major complications were encountered. In one case, no uncemented implant was available. 3 cases required exploration due to painful fibular impingement, due to choosing a large talar component. 3 fractures were encountered. Two occurred intra-operatively (one medial, one lateral), one bimalleolar fracture occurred due to minor trauma.

An overall re-operation rate of one in three cases was therefore encountered, although all cases were salvaged and all the cases still have a satisfactorily functioning implant in situ.

Many of these complications are avoidable for future surgeons. The implications and requirements for future training are discussed.

### **EFFECT OF NICOTINE ON THE RATE AND STRENGTH OF LONG BONE FRACTURE HEALING**

S.M. Raikin (Nuffield Orthopaedic Centre, Oxford, UK)

Empirical clinical observation suggests that cigarette smoking has an inhibitory effect on long bone fracture healing, but this has not been proven scientifically. Forty matched New Zealand White rabbits had midshaft osteotomies performed and plated. These were divided randomly into two groups receiving either nicotine or saline (placebo). Lateral radiographs were taken at 4, 6 and 8 weeks and showed a 17.2% average difference in callus formation between the two groups, and a significant lag in formation of cortical continuity in the nicotine group. After sacrifice the fracture healing was compared biomechanically. Three (13%) fractures showed no clinical evidence of union in the nicotine group, whereas all fractures in the control group healed. Biomechanical testing showed the nicotine exposed bones to be 26% weaker in three-point bending than were those exposed to placebo.

### **HINDFOOT ALIGNMENT IN OSTEOARTHRITIS AND RHEUMATOID ARTHRITIS OF THE ANKLE**

S. Hepple, N. Doling, I. Winson (Avon Orthopaedic Centre, Southmead Hospital, Bristol, UK)

Aim: To identify the patterns of hindfoot alignment in rheumatoid and osteoarthritis.

Methods: All patients attending foot clinic in our unit undergo radiological analysis by means of hindfoot alignment views according to the modified Cobey view as described by Saltzman. These radiographs have been retrospectively reviewed and measured according to diagnosis.

Results: Early results suggest that in osteoarthritis the ankle joint tends to move towards a varus alignment (average 3°) when compared with normal values (0.9°). The overall hindfoot alignment remains in valgus (average 4.3°) broadly similar to normal subjects (average 3.7°) suggesting that there is a compensatory valgus mal-alignment at the subtalar joint. In a small group of rheumatoid patients we have found a similar trend.

Conclusion: These findings have particular relevance in our therapeutic management of ankle pathology. When performing ankle arthrodesis or arthroplasty for these conditions it is possible to take into account and correct the ankle mal-alignment but subtalar alignment is difficult to assess and impossible to correct by a procedure at the ankle joint. The failure to address the alignment of the hindfoot as a whole may explain recurrent pain after ankle arthrodesis or even failure of ankle arthroplasty.

### **OUTCOME FOLLOWING ARTHROSCOPIC ANKLE ARTHRODESIS**

P.E. Allen, N. Doling, I.G. Winson (Avon Orthopaedic Centre, Southmead Hospital, Bristol, UK)

The purpose of this study was to assess the results following arthroscopic ankle arthrodesis. Fifty-three consecutive patients underwent 54 arthroscopic ankle arthrodeses. The majority of patients had osteoarthritis (40), or rheumatoid arthritis (10). There were 30 men. The average age was 62 years.

A two portal technique with percutaneous fixation was used. A plaster cast was maintained until union. Following an audit of the first 12 cases, a policy of immobilisation for a minimum of 12 weeks was instituted.

Complications were seen in 13 patients (24.5%). There were four cases of non-union (7.4%) and one delayed union. There were no deep infections.

We looked at the influence of the age and weight of the patient, the diagnosis and the period of immobilisation on the incidence of non-union. All non-unions and the delayed union occurred in male patients with osteoarthritis. The period of plaster immobilisation was significantly shorter in these patients. All non-unions were seen in the first 10 patients. There have been no further non-unions in the last 44 cases.

Conclusion: Arthroscopic ankle arthrodesis is a reliable and successful technique with complication rates lower than many series of open ankle arthrodesis. Immobilisation should continue for a minimum of 12 weeks.

### **MISSED DISLOCATIONS OF THE METATARSO-PHALANGEAL JOINTS**

R. Tandon, D. Stainsby (Newcastle Upon Tyne, UK)

A 21 year old male factory worker injured his left lower leg in a road traffic accident in 1992. When admitted to Hospital the left foot was swollen and bruised and there was an open division of the tendo-calcaneum. The tendon was repaired and the lower leg and ankle immobilised in plaster for 6 weeks. When in plaster, and after its removal, he complained of painful lumps in the sole of the foot but the foot was not examined or x-rayed. Subsequently, when walking he found that he had to walk on the outer border of the foot as pressure on the "lumps" in the sole caused so much pain. He found it increasingly difficult to stand all day at work.

When seen for a medical report in 1997 the 4<sup>th</sup> and 5<sup>th</sup> toes of the left foot were clawed and dislocated at the metatarso-phalangeal joints. The 4<sup>th</sup> and 5<sup>th</sup> metatarsal heads were prominent in the plantar aspect of the forefoot with overlying tender callosities. MRI scans showed the plantar plates of the dislocated joints lying on the dorsal aspect of the metatarsal heads. There was marked depression of the 4<sup>th</sup> and 5<sup>th</sup> metatarsal heads, particularly the 4<sup>th</sup> which was almost lying below the 3<sup>rd</sup> metatarsal head.

Modified Keller's procedures were carried out at operation in March 1998. Once the displaced plantar plates were replaced to their correct plantar position the 4<sup>th</sup> and 5<sup>th</sup> metatarsal heads became elevated and returned to normal alignment. The tarso-metatarsal joints were still mobile despite the 4<sup>th</sup> and 5<sup>th</sup> metatarsals being held down in plantar flexion for almost six years.

### **HOSPITAL ADMISSIONS FOR ACQUIRED TOE DEFORMITIES**

K.M. Dunn, D.J. McBride, S.A. Bridgman (Keele University School of Postgraduate Medicine, Stoke-on-Trent. UK)

Introduction: Acquired toe deformities are relatively common, but there is a relative paucity of epidemiological information. The objective of this study was to describe the epidemiology of hospital admissions for acquired toe deformities.

Methods: A descriptive study of National Health Service hospital admissions from 1988-97 in the West Midlands (UK) with a diagnosis of acquired toe deformities.

Results: The admission rates increased during the period from an average of 34 to 41 per 100,000 population per year from 1988-91 to 1994-97. This rising trend was more apparent in men, although 81% of admissions were in women. Over half of admissions were for people with a primary diagnosis of hallux valgus. The commonest operation for hallux valgus in those under 55 years was osteotomy of the first metatarsal, primary excision arthroplasty of the first metatarso-phalangeal joint was most frequent among older people. The annual operation rate for hallux rigidus was 3.5 per 100,000 with a modal age group of 45-64 years. The most common operations for hallux rigidus were primary excision arthroplasty or fusion of the first metatarso-phalangeal joint.

Conclusions: This study provides new information on the epidemiology of operation rates for acquired toe deformities. Primary excision arthroplasty of the first metatarso-phalangeal joint remains very popular despite its critics.

### **ADVANTAGES OF SEMI CLOSED OVER OPEN METHOD OF REPAIR OF RUPTURED TENDO-ACHILLES**

M. Chatterton, G. Atherton, S. Dargas, A.P.J. Henry (Derbyshire Royal Infirmary, Derby, UK)  
A retrospective survey of 49 patients with 50 spontaneous ruptures of the tendo-Achilles was made from 1 to 11 years after operation.

Sixteen had repair by a semi-closed technique and were in hospital an average of 1.3 days. All tendons healed well. One patient had a superficial wound infection which settled without antibiotics. All calves developed good power. One had an asymptomatic 10° of increased dorsiflexion. There were no re-operations, re-ruptures or significant long term complications.

Thirty-five had open repair and were in hospital an average of 3.5 days with significantly more complications (p<0.03). There were 6 wound infections, 3 requiring desloughing, 1 requiring later skin grafting, 1 requiring drainage and later curettage of a sinus. Two re-ruptured, 7 had painful adherence of the scar to the tendon and 4 had significantly residual calf muscle weakness.

Thus the semi-closed method gave as strong a repair as the open method, with fewer wound complications and a shorter hospital stay.

### **SHORTENING AND UPWARD DISPLACEMENT AT OSTEOTOMY OF 1<sup>ST</sup> METATARSAL FOR HALLUX VALGUS. THE EFFECTS ON FOREFOOT LOAD BEARING**

S. Pickering, G. Zafiropoulos, A.P.J. Henry (Derbyshire Royal Infirmary, Derby, UK)

A study of forefoot load bearing was made before and at 18 months after osteotomy of the 1<sup>st</sup> metatarsal for hallux valgus. The effects of shortening and of vertical displacement of the 1<sup>st</sup> metatarsal head at the osteotomy was studied.

137 feet in 81 patients were operated with relief of bunion pain in all but 7.

97 feet with no shortening or displacement at osteotomy had reduced loading in the big toe in 25 feet (26%), and increased metatarsal loading in 32 feet (33%). 14 feet had shortening of 5 mm or more without displacement of which 6 (43%) had reduced hallux loading and 9 (64%) increased metatarsal loading. 14 feet had shortening of 5 mm or more and upward displacement of 2 mm. 7 of these 12 (85%) had reduced hallux loading and 13 (95%) increased metatarsal loading. 12 feet had shortening combined with downward displacement, of which 4 (33%) had reduced hallux loading, and 4 (33%) increased metatarsal loading.

Thus both shortening and upward tilt at osteotomy tended to defunction the big toe, and cause load transfer to metatarsal heads, and are best avoided. Downward tilt of the head tended to counteract these efforts of shortening.

### **FOOTPRINTS IN DIFFERENT ETHNIC GROUPS IN THE INDIAN SUB-**



## **CONTINENT**

A. Naraen, A. Faraj, A.P.J. Henry (Derbyshire Royal Infirmary & Bradford Royal Infirmary, UK)

The effect of terrain of the country and shoe wear on foot shape was studied. The aim of the work was to study the ethnic influence of different geo-topographical regions on footprints of normal people and to identify the difference in footprints of the shoe wearing and bare-footed population.

1074 pairs of footprints of normal adults of the following groups were studied: 1) Tibetans, 2) Nepalese, 3) people from East Indian Plateau of Chotanagpore, 4) people from the North Indian plains, 5) people from the South Indian plains.

The parameters used were (1) the ratio of the widest part of the forefoot and the widest part of the heel, and (2) the angle formed at the heel between the first and fifth metatarsals. The results were then analysed using the 't' test.

The results were as follows:- 1) There was no significant difference in the ratio of width of the forefoot to that of hindfoot. 2) The widest angle was seen in the feet of the people of the South Indian plains and the narrowest in those of Tibetans. 3) Surprisingly, footwear did not seem to cause any narrowing of the first and fifth metatarsal angle.

Conclusion: It was concluded that in addition to the ethnic differences, the terrain of the country affected the shape of feet. This was inferred from the fact that the smallest angle between the first and fifth metatarsals was observed in the Tibetans and the largest in those of the Indians of the Southern plains. This study showed that shoes did not appear to affect the shape of feet.

## **CONFIDENTIAL QUESTIONNAIRE ON CURRENT SURGICAL PRACTICE FOR HALLUX VALGUS: RESULTS**

S.A. Bridgman, K.M. Dunn, D.J. McBride (Keele University School of Postgraduate Medicine, Stoke-on-Trent, UK)

Introduction: While a wide variety of operations for hallux valgus exist, there is little epidemiological information on variations in professional practice. There are also few randomised controlled trials to evaluate different operations. The objective of this study was to gather information about current surgical practice for hallux valgus, and views and ideas about trials.

Methods: A confidential postal questionnaire was sent out to members of the British Orthopaedic Foot Surgery Society with mailing addresses in the British Isles, and a number of other people who were suggested by respondents.

Results: 64% of the questionnaires sent out were returned from a single mailing. The mean number of patients referred with hallux valgus per year was 111 (range 10-400). There was a trend for more Keller's procedures to be carried out in older patients, whereas osteotomy was more widely used among younger people, as expected. There were strong and often conflicting responses about the use of certain surgical procedures, especially Keller's procedures and silastic implants.

Conclusions: This study suggests a wide variation in clinical practice for hallux valgus, and supports the need for more randomised controlled trials in foot surgery.

## **AUDIT OF ANKLE FRACTURES IN A DISTRICT GENERAL HOSPITAL SETTING**

R. Coull, D. Singh (Barnet General Hospital, London, UK)

We audited the short term radiological results of 97 ankle fractures treated at a district general hospital over a period of 18 months. A previous nationwide audit of over 1000 ankle fractures had shown unsatisfactory radiological results in 3.5% of all fractures and in 10% of surgically treated fractures. This audit showed unsatisfactory radiological results in 12.4% of all fractures and in over a quarter of surgically treated fractures. 8 of the 12 unacceptable results were in supination-external rotation IV injuries. In this subgroup disruption of the deltoid

ligament was more common than fracture of the medial malleolus. These poor results were attributable to a lack of understanding of the pathomechanics of ankle fractures and also to the acceptance of inadequate mortise view x-rays. By addressing these two issues we expect to improve our clinical results.

### **FOOT AND ANKLE FRACTURES IN FRONT SEAT CAR OCCUPANTS: HOW TO WALK AWAY FROM YOUR CAR CRASH**

A. Taylor, J. McMaster, P. Thomas, W.A. Wallace (Queen's Medical Centre, Nottingham, UK)

It has been observed that the rate of lower limb injuries is increasing in frontal car collisions. Projected estimates suggest that this trend will continue and in the near future lower limb injuries will become more costly than trunk and brain injuries.

This study reviews the vehicles and injuries of 35 patients who have been involved in a frontal car collision. This group has sustained 45 below knee injuries (14 tib-fib fractures, 9 malleolar fractures, 3 pilon fractures, 4 ankle dislocations, 3 talar neck fractures, 2 calcaneal fractures, 2 tarsal fractures, 1 Lisfranc fracture/dislocation and 7 metatarsal fractures). By combining this information with the currently available crash test dummy data the likely injury mechanisms have been determined.

Traditionally the level of intrusion is believed to be important in determining the severity of injury and this is the parameter used at present in crash tests. We believe a mechanistic approach should be used in determining car safety as the most serious injuries with the potential for long term disability are occurring early in the 'inertial' phase of the impact and therefore were not dependant on the level of intrusion.

### **THE ANKLE AND SUBTALAR JOINTS AFTER TIBIAL SHAFT FRACTURE: IS MALUNION IMPORTANT?**

S.A. Milner, T.R.C. Davis, K.R. Muir, D.C. Greenwood, M. Doherty (University of Nottingham, UK)

Objective: To determine whether tibial shaft fracture malunion predisposes to osteoarthritis of the adjacent ankle and subtalar joints.

Design & Setting: Retrospective review of patients treated for a tibial shaft fracture at Nottingham General Hospital between 1954 and 1967.

Subjects: 164 former patients (147 male, 17 female) with a minimum follow up of 30 years.

Main outcomes: Self reported joint pain, stiffness and disability (WOMAC osteoarthritis questionnaire); clinical signs of osteoarthritis, radiographic prevalence of osteophytes and joint space narrowing.

Main results: 8 subjects (6%) reported ankle pain of at least moderate intensity, but 27 subjects (19%) reported ankle stiffness of at least moderate severity. 17 subjects (13%) reported disability of at least moderate severity. Clinical osteoarthritis was more common on the side of the fracture in the ankle joint (ipsilateral 10.4%, contralateral 3%, bilateral 4.9%) and the subtalar joint (ipsilateral 8.5%, contralateral 1.8%, bilateral 3%). Subtalar stiffness was considerably more common on the side of the fracture (ipsilateral 26.8%, contralateral 3%, bilateral 8.5%). Ankle fracture (ipsilateral 26.8%, contralateral 3%, bilateral 8.5%). Ankle osteophytes were more common on the side of the fracture (ipsilateral 7.6%, contralateral 1.4%, bilateral 2.1%), as was joint space narrowing (ipsilateral 8.3%, contralateral 0.7%, bilateral 0%). There was no association between fracture angulation, rotation or shortening and osteoarthritis of the ankle or subtalar joints. Malalignment of the ankle joint was associated with objective subtalar stiffness, but not with clinical or radiographic ankle arthritis. Logistic regression analysis failed to identify the cause of the excess osteoarthritis in the joints on the side of the fracture.

Conclusions: The 30 year functional outcome after a tibial shaft fracture is usually good, although mild joint symptoms are common. The excess of symptomatic ankle

osteoarthritis on the side of the fracture is not caused by fracture malunion per se. Subtalar stiffness may be caused by ankle malalignment, or it may be a marker of a severe injury. Overall, most of the observed osteoarthritis was not related to factors evaluated in this study.

### **DYNAMIC RESPONSE AND INJURY MECHANISM IN THE HUMAN FOOT AND ANKLE AND AN ANALYSIS OF DUMMY BIOFIDELITY**

\*P. Manning, \*A. Wallace, C. Owen, A. Roberts, C. Oakley, R.,Lowne (\*University of Nottingham, UK. The Transport Research Laboratory, UK)

Lower leg injuries are frequent injuries (AIS>2) to car occupants resulting from frontal car impacts. It is important to be able to quantify the risk of these injuries from car crash impact tests. The need for a more biofidelic instrumented lower leg (car crash dummy) has been clearly identified.

In phase one, 24 subjects drove a simulator to investigate leg kinematics and kinetics in emergency braking. In the second phase of the work, 85 low energy impact tests have been carried out on post mortem human surrogate (PMHS) legs and 32 tests using volunteers. 60 tests were performed on existing Hybrid III and GM/FTSS dummy feet/ankles. Additional toe impact tests were performed with pre-impact bracing, allowing for future comparisons with the ALEx (Advanced Lower Extremity) leg.

In impacts, drivers applied a peak 630N to the brake pedal. This required 1.5kN of Achilles tendon force. The mean ankle articulation at peak brake force application was 15° of plantar flexion. Axial forces increase significantly with an Achilles pre-load and dorsiflexion (p<0.05). Significant differences in the response of aware and unaware volunteers were seen.

Neither dummy evaluated gave the same response as the PMHS/volunteers for all parameters (Forces/Bending moments/Movements). The GM/FTSS foot had better biofidelity all round. The Hybrid III foot was nearer to the PMHS for tibia axial force for toe impacts. In legislative testing, the representation of Achilles tension in the lower leg should be considered.

### **THE POSITION AND MOVEMENT OF THE FOOT IN EMERGENCY MANOEUVRES AND THE INFLUENCE OF TENSION IN THE ACHILLES TENDON**

\*P. Manning, \*A. Wallace, A. Roberts, C. Owen, R. Lowne (\*University of Nottingham, UK. The Transport Research Laboratory, UK)

Skeletal ankle injuries are a significant cause of temporary and permanent impairment and can lead to long term morbidity. This paper reports 28 different tests using post mortem human surrogate (PMHS) legs designed to evaluate the effect of Achilles tension on the kinetic and kinematic response of the lower leg in impact.

Plantar flexing forces of either 0,960 or 1800N were applied to the Achilles tendon in identical impact tests to the foot/ankle. These loads were calculated from a simulation of frontal impact using 12 volunteers of an advanced driving simulator. Accelerometers and load cells monitored the kinetic response of the limb. High-speed film and electronic goniometers were used to monitor the kinematic response. Axial loads of up to 5000N in the tibia were generated.

Achilles loading results in a significant enhancement of peak axial load (p<0.001) and ankle stiffness (p<0.001) but has no significant effect on bending moments induced within the tibia.

This enhanced axial load has significant implications in the understanding of Pilon, Calcaneal and Talar neck fractures. These fractures are increasingly seen in road traffic accidents.

### **IS THERE ANY RELATION BETWEEN FLAT-FOOT DEFORMITY AND INTERNAL ROTATION OF THE HIP JOINT?**

G. Zafiropoulous, T. Kouboura, G. Danis, C. Zilidis (Medical School of University of

Thessaly, Larissa, Greece)

The aim of this study is to investigate the relation of flat-foot deformity from internal rotation of the hip joint. Six hundred and fifty-one children, aged 3-6 years, were examined and Contact Index II (for flat-foot) as well as internal rotation of the hip joint were measured. Eighty-two children with other foot and leg deformities were excluded from the statistical analysis. From the remaining 569 children, 95 (16.7%) were observed to have flat-foot deformity with Contact Index II being equal or above 0.88. Fifty-six of them were found to have bilateral flat-foot deformity and 39 unilateral. All children with flat-foot deformity had raised internal rotation of the hip above 60°. None of the remaining 474 were found to have raised internal rotation of the hip joint. The regression analysis has shown a significant relation between flat-foot deformity and raised internal rotation of the hip ( $F=168.1$ ,  $p<0.001$ ,  $r=0.53$ ). In conclusion, a significant regression of flat-foot deformity from raised internal rotation of the hip joint in children between 3 and 6 years of age is verified.

#### **ASSESSMENT OF LONG TERM RESULTS OF KELLER'S PROCEDURE**

D. Prakash, J.L. Plewes (The Royal Orthopaedic Hospital NHS Trust, Northfield, Birmingham, UK)

Ninety-four feet in seventy-six patients, who had a Keller's procedure for hallux valgus, were reviewed. Different surgeons in the same hospital had performed the operation. There were sixty-seven women and nine men. The average length of follow up was 40.6 months. The average age at the time of surgery was 66.7 years (range 34 to 90).

Each patient was interviewed and questioned in detail about the operation and their response to it, and also about any subsequent problems they might have had with their feet. A modified foot-scoring system was used to assess the patients responses, which included relief of pain, ability to walk, recurrence of deformity, presence of callous and any other problems.

In fifty feet (53.8%) the second toe was longer and symptomatic following surgery. In fifteen feet (16.1%) the second toe was longer but not symptomatic. Eleven feet (11.8%) had second toe surgery at the time of Keller's operation and these second toes were either shorter or equal in length to the great toe; none of these toes were causing any symptoms. Seventeen feet (18.3%) had not had an operation on the second toes, and these toes were equal to or shorter than the great toes and were not symptomatic.

It is suggested that first ray surgery should be planned so that post-operative over-lengthening of the second toe is avoided.

#### **DOES TIBIALIS POSTERIOR TENDON TRANSFER FOR ACTIVE DORSIFLEXION OF THE FOOT INEVITABLY RESULT IN TIBIALIS POSTERIOR TENDON DYSFUNCTION?**

J.S. Yeap, D. Singh, R. Birch (Royal National Orthopaedic Hospital, Middlesex, UK)

Transfer of the tibialis posterior tendon to the dorsum of the foot is regularly performed as a treatment for footdrop secondary to common peroneal nerve palsy. This deprives the foot of a 'normally' functioning tibialis posterior tendon. On the other hand, the most common cause of adult acquired flatfoot deformity is believed to be tibialis posterior tendon dysfunction.

This study investigates whether patients who have had a tibialis posterior tendon transfer go on to develop a flatfoot or the clinical condition called tibialis posterior tendon dysfunction.

Seventeen patients, aged between 12 and 73 years old at the time of surgery, with a mean follow up of 62 months from surgery have been studied. None of the patients had flatfeet before the onset of their nerve injury. A slight flattening of the medial longitudinal arch, as shown by Harris-Beath footprint was found in 23.5% of the patients but this did not cause the patients any symptoms. Hindfoot valgus was seen in 17.6% of the cases.

This would suggest that muscular imbalance on its own is insufficient to cause the development of signs of tibialis posterior tendon dysfunction in an intrinsically and

biomechanically stable foot.

### **FIRST METATARSO-PHALANGEAL JOINT ARTHROSCOPY**

M.S. Davies, T.S. Saxby (London, UK)

Twelve arthroscopies of the first MTP joint were carried out in 11 patients over a 5 year period. The mean age at operation was 30 years and the mean duration of symptoms prior to surgery was 8 months. Six had a history of significant trauma and all had swelling, tenderness and decreased motion prior to surgery. Under general anaesthesia at 1.9 mm 30° arthroscope was used to visualise the joint via three standard portals. All patients had intra-articular pathology. The two most common findings were synovitis and metatarsal head OCD. At a mean follow up of 19 months all patients had no or minimal pain, decreased swelling and increased motion.

### **A PRELIMINARY REPORT OF THE FOOT DEFORMITIES IN PATIENTS WITH LEPROSY**

R. Brown, D. Lockwood, L. Williams (The Middlesex Hospital, London, UK)

Introduction: Leprosy is a major global disease, with falling prevalence. However, increased travel and immigration may result in increased presentation of leprotic foot deformities to orthopaedic surgeons in countries of low prevalence. The late effects of the neuropathy commonly involve the feet, resulting in ulceration in 26% and deformity in 55%.

Method: We reviewed 15 patients from consecutive leprosy clinics in London in Spring 1998.

Results: The mean age was 63, ranging from 16 to 85 years. The mean time from infection was 27 years. Lepromatous leprosy predominated.

73% had a sensory neuropathy, with the common peroneal and tibial nerves most commonly involved. Ulceration complicated 53% of cases, most commonly on the plantar surface under the bases of the lesser toes or the hallux. This pattern has been recorded before.

Eleven cases had a foot deformity, including severe hindfoot varus, Charcot ankle joint, pes planus and toe deformities, such as claw toe (36%), hallux valgus (27%) and hallux varus (9%). 33% had undergone previous foot surgery, including tibialis posterior tendon transfers and amputations.

Conclusion: Surgeons must be vigilant for the frequent foot deformities in the few leprosy patients who have travelled to England.

### **ANKLE ARTHRITIS FOLLOWING TRIPLE ARTHRODESIS: A LONG TERM FOLLOW UP**

P. Desai, P. Sonsale, M. Stamatias, A.P.J. Henry (Derby, UK)

From 1977 to 1994, 67 patients were operated for triple arthrodesis at Derbyshire Royal Infirmary, 25 of them were reviewed after a mean follow up of 9.92 years with longest follow up of 22 years. There were 13 males and 12 females. Mean age of the patients was 57.24 years.

We assessed them using various clinical and radiological criteria. The clinical criteria included pain level, walking distance, appearance of the foot, type of shoe wear possible. Range of movement of ankle was assessed to see the long term effects of triple arthrodesis. Finally patient satisfaction was also assessed. Radiological evaluation included AP and lateral x-ray of the foot. Ankle joint degeneration was assessed. Talo-calcaneal and talus and 1<sup>st</sup> metatarsal angle was also measured.

Indications for triple arthrodesis were rheumatoid arthritis (10 patients), neurological disorders like polio, CP, Charcot-Marie-Tooth syndrome (5 patients), osteoarthritis (7 patients) and congenital foot deformities (3 patients).

Twelve patients (44%) had staples used for triple arthrodesis. In 13 patients feet were immobilised in below knee weight bearing POP. 24 patients (96%) were satisfied with the result of the operation. There was no residual deformity in 17 patients (68%); 5 patients

(20%) had valgus deformity (mean 8°); 3 patients had mild heel varus and one patient had deformity at the ankle joint of 25°; 16 patients (64%) had radiological evidence of ankle arthritis; 2 patients had ankle fusion done prior to this operation for previous problem; 3 patients had ankle fusion done at a later stage. Thus, 5 patients (20%) had ankle arthrodesis. Three patients had lateral plantar nerve involvement and had some residual pain around the scar. Two patients had infection and this was treated by long term antibiotics. Ten patients (40%) had restricted mobility. Ankle arthritis was one of the limiting factors in determining the mobility of these patients.

Thus we conclude that triple arthrodesis is a good procedure for providing pain relief and improving mobility of the patients. In our series there was also associated ankle arthritis. Majority of the patients had multiple joint involvement due to RA or neurological disorder.

### **WHAT IS A MODIFIED MITCHELL'S OSTEOTOMY?**

A. Gower, M.E. Greiss, P.J. Briggs (West Cumberland Hospital, Cumbria, UK)

Introduction: Since Mitchell first described his distal first metatarsal osteotomy a number of modifications appear to have arisen in current practice. We sought to determine how this procedure was now being performed and what constitutes a modified Mitchell's osteotomy.

Method: A questionnaire was sent to all 71 orthopaedic consultants in the Northern Region. We asked about their preferred surgical techniques for hallux valgus, their selection criteria, and details of their surgical technique. Their techniques were then compared with the original description of the technique given in 1958.

Results: 54 consultants (76%) responded. 85% operate on feet and 26% declared an interest in foot surgery. 31 consultants (67%) do a Mitchell's type osteotomy for hallux valgus without osteoarthritis. 74% considered a painful bunion to be an important factor in selection of patients for surgery, but only 52% felt that the degree of deformity was important in the selection of the procedure. Only 13% considered prophylaxis against future deformity progression to be important.

Only one surgeon performed a Mitchell's osteotomy as it was originally described in 1958.

Conclusions: Mitchell's osteotomy now appears to be performed in a variety of different ways. Some modifications, such as the plantar displacement of the metatarsal head have been shown to be important, but many other modifications are not supported by scientific evidence. Multicentre studies are not feasible unless methods are standardised. Changes to established techniques should be supported by appropriate outcome studies.

### **FOOT REPLANTATION**

N. Koryshkov, M. Novikov, K. Pshenisnov, A. Chtcherbakov, S. Platonov, V. Cherujaev, S. Larioudv (Yaroslavl State Medical Academy, Russian Foot & Ankle Society, Russia)

A male, 34, sustained foot trauma as a result of an accident at a plant. He was brought to the emergency surgery department at the hospital in Yaroslavl, 40 minutes after the trauma. After examination the clinical diagnosis was complete avulsion of the right foot at the level of the talo-calcaneal and transverse joints.

After surgical pre-treatment, replantation of the right foot was performed. The talo-calcaneal joint was fixed with Kirschner wires.

Next day, to cover the defects over the front surface of the foot, a microsurgical operation was performed with muscular graft of straight abdominal muscle. The artery of the graft was used as a central vessel. The perforated and split skin graft was placed upon the muscular graft. Fascial beds of the foot were decompressed. There were no complications during the post operative period.

In six weeks the blood supply in the operated foot was satisfactory. The wires were taken out and compression dressing of talo-calcaneal and transverse joints was done. Passive movement of the ankle joint was restored.

Three months later plastic surgery to the tibial nerve was performed.

During the post operative period the control of blood circulation of the foot was carried out by thermometry, reografy (impedance plethysmography) and Doppler ultrasonic apparatus. As a result improvement of blood circulation in the foot was observed.

Fixation of free ends of the tendons in the area of the cicatrix made it possible to partly restore active movements in the foot.

Now seven months after the replantation the patient can walk without any support.

## **THE INTRODUCTION OF NEW INSTRUMENTATION FOR METATARSO-PHALANGEAL FUSION**

B.C. Hughes, L. Zolcer, F. Kashir (Mayday University, Croydon, UK)

Introduction: We describe the use of new instrumentation, which have been designed to assist in arthrodesis of the first metatarso-phalangeal joint.

Methods: Two instruments have been designed which assist in obtaining good alignment of the first metatarsal and proximal phalanx and allows for variation of the angles of valgus and dorsiflexion at the time of surgery. A hemispherical reamer (ENDO.PLUS UK) allows for shaping of the metatarsal head whilst excising the degenerate joint surface. A corresponding convex reamer is used to shape the proximal phalanx to allow for accurate alignment of the metatarsal and phalangeal surfaces, which fit together, like a universal joint. The angles of valgus and dorsiflexion may be altered as required and subsequently fixed with a Kirschner wire or screw.

Results: 15 patients underwent this procedure over a 3 year period. There were no complications and all had an excellent result.

Conclusion: These new instruments aid in the positioning of the fusion angle and allow for variation at the time of surgery and thus help prevent complications from malalignment of the fusion. Early results from this procedure look promising but long term follow up is necessary to establish definite advantage.

## **OUTCOME FOLLOWING KELLER'S ARTHROPLASTY FOR ADULT HALLUX VALGUS PERFORMED AT A DISTRICT GENERAL HOSPITAL**

S.K. Pande, R. F. Adam (Ormskirk & District General Hospital, Lancs, UK)

Aid of study: To determine the subjective and objective outcome after Keller's arthroplasty performed for adult hallux valgus.

Material & Methods: 32 patients (49 feet) with a follow up of 1 to 7 years were assessed clinically and radiologically.

Results: The average age of the patient was 62.5 years. In 48% of feet, complete relief of symptoms was recorded. Of the 96% of feet having significant pain before operation, 50% continued to have pain of lesser severity post operatively. In 85% of instances, difficulty using regular footwear was reported. Of these 79% were back to using regular footwear post operatively. Seventeen feet had pre-operative metatarsalgia, of these 8 continued and 10 new feet developed metatarsalgia post operatively. Though this had no effect on the final outcome, it was the most common cause for patient dissatisfaction. Complications were seen in 43% feet. These included metatarsalgia (39%) and damage to the dorsal cutaneous nerve of great toe (20%). The subjective patient satisfaction was 76%. Using the Bonney & MacNab grading system, 87% feet had good-excellent result.

Conclusion: Keller resection arthroplasty is a reasonable alternative for the treatment of adult hallux valgus. Patients must be informed of the possibility of post operative metatarsalgia.

## **HEEL SUPINATION: THE ROLE OF THE PLANTAR FASCIA, METATARSAL OBLIQUITY, AND MUSCULAR ACTION**

P. Tansey, P.J. Briggs (Freeman Hospital, Newcastle upon Tyne, UK)

Introduction: Failure of heel supination on heel elevation during gait and standing tiptoe has

been regarded as a feature of tibialis posterior tendon rupture. However, a number of other mechanisms such as the reverse windlass mechanism of the plantar fascia, the obliquity of the metatarsal break, and the action of other muscles such as the gastrocnemius–soleus complex may contribute to normal heel supination. In 20 individuals we attempted to determine the relative importance of these different mechanisms.

**Methods:** Heel supination was measured using an electrometer (Rx Laboratories), in response to toe extension, tiptoe standing and using a specially designed platform which enabled tiptoe standing without toe extension, thus eliminating the windlass mechanism. Intra-observer and inter-subject variability was assessed.

**Results:** Passive toe extension to 45° (windlass effect) produced heel inversion to 5.0 3.2°, and normal tiptoe standing to 45° (windlass and muscular effect) caused heel inversion to 7.8 3.5°. Standing tiptoe on the platform without toe extension (muscular effect) caused heel inversion to 3.3 2.7°. With the platform positioned obliquely in line with the metatarsal break (muscular effect and metatarsal obliquity), heel inversion to 4.2 2.6° occurred.

**Conclusion:** This simple study demonstrates that heel supination on standing tiptoe is caused by a number of mechanisms and in normal feet the reverse windlass mechanism of the plantar fascia would appear to contribute about 50% of this movement, although there was significant inter-subject variation. Increased heel supination was seen if the platform was positioned obliquely, simulating tiptoe stance on the lateral four metatarsals but did not reach the magnitude seen when the plantar fascia was activated in the normal tiptoe test. Loss of heel supination associated with tibialis posterior tendon rupture suggests that there must, in addition, be failure of other mechanisms such as the reverse windlass mechanism.

## **A REVERSED Z-PLASTY SKIN INCISION FOR ACHILLES TENDON RECONSTRUCTION**

S. Green, P.J. Briggs (Freeman Hospital, Newcastle upon Tyne, UK)

**Introduction:** Achilles tendon repair, and more especially, reconstruction of neglected tendon ruptures, is associated with an increased incident of wound healing problems. Insufficient circumferential laxity of the skin because of soft tissue swelling and loss of the Achilles tendon retinaculum may lead to difficulties in the closure of longitudinal incisions despite there being sufficient laxity of the skin in a vertical direction.

**Methods & Results:** A reversed z-plasty skin incision had been utilised in 5 patients undergoing Achilles tendon reconstruction with flexor hallucis longus or flexor digitorum longus tendon transfer. The incision is postero-medial incorporating the reversed z-plasty at the malleolar level. Full thickness flaps are elevated. At wound closure the flaps are reversed utilising the longitudinal skin laxity to increase the circumferential skin laxity. It was possible to close all wounds without tension and all have healed without difficulty with a cosmetically acceptable result.

**Conclusions:** A variety of techniques have been suggested to aid wound closure in Achilles tendon repair and reconstruction, including the use of lazy S incisions, or the pre-operative use of tissue expanders. Although this is a small group of patients, the ease with which wound closure has been obtained with the reversed z-plasty incision leads us to recommend this simple technique. The nature of the technique, however, means that the surgeon must anticipate the potential problem with wound closure before making the skin incision.

## **HICK'S REVISITED: A WEIGHTBEARING IN VIVO STUDY OF THE BIOMECHANICS OF THE PLANTAR FASCIA EMPLOYING 'DYNAMIC' M.R.I**

\*A. Williams, V. Vedi, \*D. Singh, W. Gedroye, D Hunt (\*Royal National Orthopaedic Hospital, Stanmore, UK. St Mary's Hospital, London, UK)

The plantar fascia has been described as a 'tie-bar' maintaining the longitudinal arch of the foot. The right foot of 6 healthy volunteers were studied during near 'real-time' imaging of



the plantar fascia during the stages of the gait cycle.

The plantar fascia appeared relaxed during non-weight bearing and during all phases of weight bearing except during the last phase of stance as the toes dorsiflexed. This supports Hick's theory that the foot functions both as a tie-bar and a longitudinal beam. The tie-bar action appears to be only active at the end of the stance phase.

### **FIRST METATARSO-PHALANGEAL JOINT FUSION: A LOW PROFILE PLATE TECHNIQUE**

A.J.A. Santini, C.R. Walker (The Royal Liverpool & Broadgreen University Hospitals, Liverpool, UK)

**Introduction:** Various techniques of fusing the first metatarso-phalangeal joint have been described. We present the results of arthrodesis of the first metatarso-phalangeal joint with a low profile dorsal vitallium plate and a lagged interfragmentary screw (Luhr, Howmedica).

**Methods:** Through a dorsal incision, the articular cartilage is resected using Coughlin spherical reamers. The interfragmentary screw is passed across the joint with the vitallium plate secured dorsally.

**Results:** Twenty-six patients underwent 30 first metatarso-phalangeal joint arthrodesis. All but one joint fused clinically and radiologically at a mean of 7.8 weeks. Post-operatively, the foot scores improved from 47 to 80, supporting the clinical findings of good post-operative pain relief. One patient had medial hallux hyposensitivity. Two patients had mild post-operative pain not related to the metalwork. One patient, with rheumatoid arthritis and microvascular disease, had an infected non-union requiring metalwork removal.

**Conclusions:** We propose that arthrodesis of the first metatarso-phalangeal joint with a low profile dorsal vitallium plate gives good post-operative pain relief and low incidence of complications including those related to the metalwork.

### **NON-SURGICAL MANAGEMENT OF TIBIALIS POSTERIOR INSUFFICIENCY**

S. Jari, N. Roberts, J.L. Barrie (Blackburn Royal Infirmary, Lancs, UK)

We treated 45 feet in 40 patients for tibialis posterior insufficiency and staged them according to the modified Johnson and Strom system. All patients were treated conservatively in the first instance. Six feet in 5 patients have been operated on. Thirty-one feet in 28 patients, treated only by non-operative means, were reviewed by an independent assessor according to the AOFAS ankle/hindfoot scale.

All but 5 patients reviewed were satisfied with the outcome of their treatment, and only one patient has requested surgery.

### **ONE YEAR OF ANKLE FRACTURES IN A DISTRICT HOSPITAL: A CRITERION BASED AUDIT**

E.R. Jago, B. Thennavan, J.L. Barrie (Blackburn Royal Infirmary, Lancs, UK)

We audited all adult malleolar fractures treated in Blackburn during 1996.

There were 171 fractures in 170 patients. 111 fractures were treated non-operatively, 23 by manipulation and 37 by internal fixation.

**Non-operative group:** Of 111 fractures treated non-operatively, 66 were stable, 44 were possibly unstable and one was displaced at presentation. Four fractures were fixed, two probably unnecessarily. One fracture was treated by MUA, probably unnecessarily.

**MUA group:** Good position was obtained in all but one case, which was re-manipulated. Mean time in cast was 6.95 weeks, mean time non-weight bearing was 3.48 weeks and mean number of X-rays was 3.22. There were 3 complications.

**ORIF group:** The most senior surgeon was a consultant in 62.2% and a SpR in 35.1%. A good reduction was obtained and fixation was by AO technique in all cases. Mean time in splintage was 6.68 weeks, mean time non-weight bearing was 4 weeks and mean number of X-rays was 4. There were 5 complications. 14 patients have subsequently had their metalwork removed.

