Abstract Service

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The influence of external precipitating factors and peripheral neuropathy on the development and outcome of diabetic foot ulcers.

Apelqvist J, Larsson J, Agardh CD. J. Diabetic Complications. 1990; 4: 21 – 5

The influence of external precipitating factors and the presence of peripheral neuropathy on the development and outcome of foot ulcers were evaluated in 314 consecutive diabetic patients. All patients were treated by the same foot care team. Each patient was represented by one ulcer, and primary healing was defined as intact skin for at least 6 months. External precipitating factors were identifiable in 264 of 314 patients. The most common factors were ill-fitting shoes/socks, acute mechanical trauma, stress ulcer, and paronychia. The highest primary healing rates were seen in lesions caused by paronychia (84%) and stress ulcer (76%). Clinical signs of sensory and muscular disturbances were seen in the majority of patients (96%). Sensory neuropathy, evaluated with a biothesiometer, was more common among patients who had amputations or, died subsequently compared to those who healed. This study suggests that a majority of diabetic foot ulcers might have been prevented, since a precipitating external factor was identified in four out of five patients stressing the importance of preventive foot care.

Autonomic denervation may be a prerequisite of diabetic neuropathic foot ulceration.

Ryder RE, Kennedy RL, Newrick PG, Wilson RM, Ward JD, Hardisty CA. Diabetic Med. 1990; 718: 726-30

Studies using visceral (cardiovascular) autonomic function testing have left doubt as to the importance of autonomic neuropathy in the development of diabetic neuropathic foot ulceration. A test for peripheral autonomic denervation has been developed (acetylcholine sweatspot test), dependent on intradermal acetyl choline causing secretion by innervated sweat glands, detected by starch/iodine discoloration. The response is photo-graphed and quantified using a grid (normal score = 0 or 1; abnormal = 5 - 60). The sweatspot test was applied to the feet of 19 diabetic patients with a history of foot ulceration, 17 with neuropathic pain, eight complaining of numbness, and to 15 diabetic control patients. The sweatspot test score of the foot ulcer patients (median 54) was very much greater than that of the other groups (pain group, 4, $p < 0.005$; numbness group, 2, $p < 0.01$; diabetic control group, 2, $p < 0.0001$). All the patients with neuropathic foot ulceration had peripheral autonomic denervation. The result suggest that autonomic denervation in the feet is always present in patients with diabetic neuropathic foot ulceration. Tests of peripheral autonomic denervation such as the acetylcholine sweat spot test may be useful to identify patients at risk of neuropathic foot ulceration.

Peripheral blood flow control in diabetes mellitus.

Hilsted J. ActaPhysiol. Scand. 1991; 603: 47-51.

Long term diabetes has a profound effect on the peripheral circulation. This has been demonstrated to be due to the presence of angiopathy and autonomic neuropathy, affecting autoregulation and distensibility of the vessels as well local and central reflex regulation of the vascular resistance. Whereas the hemodynamic consequences of vascular denervation are well known (causing blood pressure maladaptation to a number of stimuli such as standing, exercise and agonist infusion), the consequences of disturbances in autoregulation and distensibility remain to be established.

Clinical presentation and management of diabetic neuropathy and foot ulceration.

Boulton AJ. Diabetic Med. 1991; 8: S52-7.

A simple classification of the more common neuropathies is presented. The most frequent disorder in diabetes is a symmetrical sensory polyneuropathy in the lower limbs. Acute sensory polyneuropathies frequently follow sudden metabolic disturbance although there may be little evidence of neurological abnormalities on clinical examination. Similar symptoms occur with chronic sensory polyneuropathy but onset is gradual and this condition may persist for years with only minor symptoms. A significant proportion of patients with chronic polyneuropathies have few if any symptoms and are only diagnosed by careful clinical examination. An approach to the diagnosis and management of symptomatic sensory polyneuropathy is suggested. Sensory loss and the possible complication of vascular dysfunction, greatly increase the risk of insensitive foot lesions in diabetic patients. Some may progress to the insensitive foot without prior evidence of neuropathy. Regular and thorough examination is therefore the only way to identify patients at risk who then require education in preventative foot care. The identification of such patients and the clinical presentation and management of foot ulcers is discussed.

Prognostic value of systolic ankle and toe blood pressure levels in outcome of diabetic foot ulcer.

Jan Apelqvist, Jan Castenfors, Jan Larsson, Anders Stenstrom, Carl-David Agardh. Diabetes Care. 1989; 12: 373-8

The prognostic value of distal blood pressure measurements has been studied in 314 consecutive diabetic patients with foot ulcers. Systolic toe blood pressure was measured with a strain gauge technique, and ankle pressure was measured with strain-gauge or Doppler techniques. Wound healing was defined as intact skin for at least 6 mo. One hundred ninety-seven patients healed primarily, 77 had amputations, and 40 died before healing had occurred. In 294 of 300 patients, it was possible to measure either ankle or toe pressure. Fourteen patients were not available for pressure measurements. Of these, 10 patients healed primarily, and died before healing occurred. Both ankle and toe pressures were higher ($P < 0.001$) among patients who healed without amputation compared with those who underwent amputation or died before healing. No differences were seen in ankle or toe pressure levels among those who had amputations or died. No patient healed primarily with an ankle pressure < 40 mmHg. An upper limit above which amputation was not required could not be defined. Primary healing was achieved in 139 of 164 patient (85%) with a toe pressure level > 45 mmHg, whereas 43 of 117 patients (36%; $P < 0.001$) healed without amputation when toe pressure was < 45 mmHg. In conclusion, a combination of ankle and toe pressure measurements is a useful tool to predict primary healing in diabetic foot ulcers.

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Pathways to diabetic limb amputation basis for prevention.

Roger E. Pecoraro, Gayle E. Reiber, Ernest M. Burgess. Diabetes Care. 1990; 13: 513-21

We defined the causal pathways responsible for 80 consecutive initial lower-extremity amputations to an extremity in diabetic patients at the Seattle Veterans Affairs Medical Center over a 30-mo interval from 1984 to 1987. Causal pathways, either unitary or composed of various combinations of seven potential causes (i.e. ischaemia, infection neuropathy, faulty wound healing, minor trauma, cutaneous ulceration, gangrene), were determined empirically after a synthesis by the investigators of various objective and subjective data. Estimates of the proportion of amputations that could be ascribed to each component cause were calculated. Twenty-three unique causal pathways to diabetic limb amputation were identified. Eight frequent constellations of component causes resulted in 73% of the amputations. Most pathways were composed of multiple causes, with only critical ischaemia from acute arterial occlusions responsible for amputations as a singular cause. The causal sequences of minor trauma, cutaneous ulceration, and wound-healing failure applied to 72% of the amputations, often with the additional association of infection and gangrene. We specified precise criteria in the definition of causal pathway to permit estimation of the cumulative proportion of amputations due to various causes. Forty-six percent of amputations were attributed to ischaemia, 59% to infection, 61% to neuropathy, 81% to faulty wound healing, 84% to ulceration, 55% to gangrene, and 81% to initial minor trauma. An identifiable and potentially preventable pivotal, event, in most cases an episode involving minor trauma that caused cutaneous injury, precedeed 69 of 80 amputations. Defining causal pathways that predispose to diabetic limb amputation suggests practical interventions that may be effective in preventing diabetic limb loss.

Relationship of limited joint mobility to abnormal foot pressures and diabetic foot ulceration.

Devaka J.S.Fernando, Ewan A.Masson, Aristidis Veves, Andrew J.M.Boulton. Diabetic Care. 1991; 14: 8-11

Objective: To investigate the role of limited joint mobility (LJM) in causing abnormal foot pressures and foot ulceration.

Research Design and Methods: The subjects were recruited from a general diabetes clinic where patients were screened for neuropathy, retinopathy, and elevated plantar foot pressure. Sixty-four patients in five groups were matched by age and sex in the following groups: group 1, patients with LJM and neuropathy; group 2, non-neuropathic diabetic patients with LJM; group 3, patients with neuropathy and no LJM; group 4, diabetic control subjects; and group 5, nondiabetic control subjects. Joint mobility was assessed in the foot at subtalar and metatarsophalangeal joints; plantar foot pressures were assessed by optical pedobarography and neuropathic status by a Biothesiometer and electrophysiology.

Results: Joint mobility was reduced at both sites in groups 1 and 2 compared with groups 3, 4 and 5 ($P<0.001$). Plantar foot pressures were significantly higher in groups 1 and 2 compared with groups 3, 4 and 5 ($P<0.01$). No differences in plantar foot pressures were observed between groups 1 and 2. There were strong correlations between plantar foot pressures and joint mobility in the foot ($r = -0.7$, $P < 0.001$). Previous foot ulceration was present in 65% of patients in group 1, none in group 2, and 5% in-group 3.

Conclusions: 1) LJM may be a major factor in causing abnormally high plantar foot pressures, 2) abnormal plantar foot pressures alone do not lead to foot ulceration, and 3) LJM contributes to foot ulceration in the susceptible neuropathic foot.

Use of experimental padded hosiery to reduce abnormal foot pressures in diabetic neuropathy.

Aristidis Veves, Ewan A. Masson, Devaka J.S. Fernando, Andrew J.M. Boulton. Diabetes Care. 1989; 12: 653-5

High pressures under the feet of diabetic patients with neuropathy are associated with the development of plantar ulceration. The aim of management is the reduction of such stresses with orthoses and insoles. An American hosiery manufacturer has developed socks designed to reduce stress on athletes' feet, and we report a preliminary evaluation of this technique in the reduction of elevated plantar pressure in 27 neuropathic diabetic patients. With a computerised optical pedobarograph, three footsteps on each side were recorded under three conditions: 1) barefoot, 2) wearing the patients' own hosiery, and 3) wearing experimental patented padded hosiery. The patients' own hosiery did not have a significant effect on plantar pressure, but the experimental hosiery reduced both peak forefoot pressure and the area under the time-pressure curve ($P < 0.001$) by a mean of 26 and 29%, respectively. We conclude that the experimental hosiery is effective in reducing vertical pressures under the diabetic foot and, in conjunction with established orthotic techniques, may be a useful addition to the treatment of the diabetic patient at risk for foot ulceration.

Lower – extremity amputation in people with diabetes. Epidemiology and Prevention.

Diane E. Bild, Joseph V Selby, Pomeroy Sinnock, Warren S.Browner, Paula Braveman, Jonathon A. Showstack. Diabetes Care. 1989; 12: 24 - 31.

The age-adjusted rate of lower-extremity amputation (LEA) in the diabetic population is approximately 15 times that of the nondiabetic population. Over 50,000 LEAs were performed on individuals with diabetes, in the United States in 1985. Among individuals with diabetes, peripheral neuropathy and peripheral vascular disease (PVD) are major predisposing factors for LEA. Lack of adequate foot care and infection are additional risk factors. Several large clinical centres have experienced a 44 – 85% reduction in the rate of amputations among individuals with diabetes after the implementation of improved foot-care programs. Programs to reduce amputations among people with diabetes in primary care settings should identify those at high risk; clinically evaluate individuals to determine specific risk status; ensure appropriate preventive therapy, treatment for foot problems, and followup; provide patient education; and when necessary, refer patients to specialists, including health-care professionals for diagnostic and therapeutic interventions and shoe fitters for proper footwear. Programs should monitor and evaluate their activities and outcomes. Many issues related to the aetiology and prevention of LEAs require further research.

Clinical evaluation of a semi permeable polymeric membrane dressing for the treatment of chronic diabetic foot ulcers.

John D. Blackman, Daniel Senseng, Lauretta Quinn, Theodore Mazzone. Diabetes Care. 1994; 17: 322-5

Objective: To evaluate the utility of a semipermeable polymeric membrane dressing for the treatment of chronic diabetic foot ulcers.

Research Design And Methods: Nineteen subjects with either insulin-dependent diabetes mellitus (IDDM) or non-insulin-dependent diabetes mellitus (NIDDM) and foot ulcers were randomly assigned to the polymeric dressing or conventional wet-to dry saline dressings. Subjects had foot ulcer site measurements performed every 3 weeks. The subjects using conventional therapy were allowed to cross over to polymeric dressing after 2 months.

Results: At the end of 2 months in the patients using the polymeric dressing, ulcer size was reduced to 35 ± 16% of baseline. The patients on conventional therapy had an ulcer size of 105 ± 28% of baseline ($P < 0.03$, polymeric vs. conventional).

Patients initially treated with wet-to dry saline were crossed over into the polymeric membrane treatment and demonstrated a decrease to 35 ± 11% of baseline size ($P < 0.02$) after an additional 2 months.

Conclusions: The semipermeable polymeric membrane dressing is useful therapeutic option for treating uncomplicated chronic diabetic foot ulcers.

Radiographic abnormalities in the feet of patients with diabetic neuropathy.

Peter R. Cavanagh, Matthew J. Young, Judith E. Adams, Karen L. Vickers, Andrew J. M. Boulton. Diabetes Care. 1994; 17: 201 – 9.

Objective: To investigate the prevalence of radiographic bone and joint abnormalities in the feet of diabetic patients.

Research Design And Methods: In a blinded randomized study, 94 diabetic patients with peripheral neuropathy (54 with a history of foot ulcers) and 43 non-neuropathic patients were drawn at random from the data base of a large university diabetes clinic in the United Kingdom. Fifty non-diabetic age-matched control subjects also were studied. Lateral and dorsi-plantar weight-bearing plain radiographs of the foot and ankle were taken by a single radiographer. Abnormalities in the bones and joints were determined according to a structured reading of the radiographs by a single radiologist.

Results: Diabetes per se resulted in no excess of bony abnormality. Diabetic patients with neuropathy had significantly more radiographic abnormalities of the bones and joints than non-neuropathic and age-matched nondiabetic control subjects. However, except for periosteal reaction, this was predominantly caused by an excess of abnormalities in diabetic patients with a history of foot ulceration. Traumatic fractures (mostly previously unrecognised) were found in 12 (22%) of the 54 neuropathic patients with previous foot ulceration, and 9 (16%) patients who had experienced foot ulcers exhibited characteristic Charcot changes.

Conclusions: These results suggest that bony abnormalities, particularly Charcot changes and traumatic fractures, are more frequent than previously recognized in neuropathic diabetic patients, especially in those with a history of foot ulceration. Early recognition of bony abnormality and appropriate treatment may prevent progression of foot deformity and thereby reduce the morbidity caused by ulceration or reulceration.

Management of the diabetic foot.

Michael Edmonds, Alethea Foster. IDF Bulletin. 1993;38:14-7

Care of diabetic foot requires a close liaison among podiatrist, diabetologist, orthotist, nurse, and surgeon. The optimal forum for this approach is the diabetic foot clinic, in which continuous co-operative care is provided by the health-care team. The diabetic foot can show two distinct types of problems:

1) the neuropathic foot, in which neuropathy dominates and

2) the neuroischemic foot, in which occlusive vascular disease is the main factor (although neuropathy may also be present.) These complications require separate therapeutic strategies.

Infections of the diabetic foot.

V Bozikov, D Pehar, N Car, Pavlic-Renar, Kucisec-Tepes, J Skrlin, Diabetologia Croatica. 1993; 22: 75 – 8.

At our institute, 196 diabetic patients were hospitalized due to diabetic foot during a five-year period. Only seventeen had IDDM, 122 were men and the mean duration of diabetes was 14 years. Only six patients did not have diabetic retinopathy and three patients did not have neuropathy. Forty-three patients had nephropathy and 64 had cardiovascular complications. X-ray revealed foot changes in 145 patients. In microbiologic samples, fourteen different kinds of microorganisms were found, microaerophils and aerobes dominating in great number. Due to polymicrobic infection, treatment is directed at aerobic and anaerobic bacteria. In the majority of patients, treatment began with a clindamicyn-aminoglycoside combination (sometimes with ampicillin to provide coverage enterococci). The duration of hospitalization was 19 days, while other patients were hospitalized for approximately 11 days. The condition of 135 (60%) of the patients improved with conventional therapy and necrectomy. Twenty-six (13%) of the patients had toe amputations, 8 (4%) had transmetatarsal amputation, 19 (10%) had lower leg or upper leg amputation and 5 (2.6%) refused amputation. Only 2 (1%) patients died.

Trophic ischemic lesions of lower limbs and diabetes.

M. Korsic, F. Coce, L. Loncaric, K. Piljek. Diabetologia Croatica. 1992; 21: 25 –8

The retrospective study of 155 patients with unilateral or bilateral obliterative atherosclerosis has included 114 lower limbs in 65 diabetics and 145 lower limbs in 90 non-diabetics. Ischemic lesions have been found in 54% of diabetic extremities. Thirteen lower limbs have not been analyzed further due to the value of ankle systolic pressure index being more than 1.5. The relation between incidence frequency of trophic ischemic lesions of lower limbs and age, sex, ASPI value, occurrence of pain and claudication has been examined. Trophic ischemic lesions have been analyzed concerning depth and site in the group of diabetics. In the group of non-diabetic examinees, a significant relation was not found between ischemic lesions and age and sex, opposed to results in the group of diabetic examinees. A significant connection between the incidence of intermittent claudications and trophic lesions exists in the non-diabetic group only. It remains to emphasize the relation between ischemic lesions and the value

of hemoglobin A1c percentage as a parameter of diabetes regulation.

Skeletal lesions of the feet in diabetics and their relationship to cutaneous erythema with or without necrosis on the feet.

Folke Lithner, Seven-Ola Hietala. Acta Med. Scand. 1976; 200: 155 – 61.

Seventy patients with cutaneous erythema of the feet with or without necrosis were the subjects of this investigation. Sixty-five of them had open diabetes. The glucose tolerance of the remaining five patients was altered in a diabetic direction. Twenty-seven of the 70 patients had roentgenologically demonstrable destruction in the bones of the feet. These 70 patients were compared with 61 diabetic control patients of corresponding age and duration of diabetes but without these skin lesions of the feet. Only four of the 61 control patients had destruction in the bones of the feet and all these destructions were small. Precipitating factors were identified in general for skin lesions, the most common being cardiac decompensation. A higher frequency of precipitating factors was seen in patients with skeletal destructions than in those without. The skeletal destructions and cutaneous necrosis are supposed to be equivalent lesions, localized to different tissues in the feet. When patients presenting skin lesions of the feet in the form of distal gangrene were compared with those who had cutaneous erythema and necrosis of the feet, but no distal gangrene, no differences were found with respect to age, duration of diabetes, occurrence of precipitating factors and the occurrence of skeletal destruction. Cutaneous erythema without necrosis is understood to be incipient diabetic gangrene.

Osteopenia and metatarsal fractures in diabetic neuropathy.

T. F. Cundy, M. E. Edmonds, P. J. Watkins. Diabetic Medicine. 1985; 2: 461- 4.

Radiographs of the hands and feet of 19 diabetic patients with severe neuropathy were compared to those of 22 control patients without neuropathy. The two groups were matched for age, sex, and duration of diabetes. Cortical bone mass, measured by x-ray morphometry, was significantly lower in both the hands ($P < 0.002$) and the feet ($p < 0.001$) of those with neuropathy. The osteopenia was worse in the feet than the hand also worse in women. Serum alklaine phosphatase levels were also significantly higher in the neuropathy group ($p < 0.005$). Metatarsal fractures were a frequent finding in the neuropathic patients, but were not seen in controls. The presence of metatarsal fractures was strongly associated with the subsequent development of diabetic osteopathy ($p < 0.001$). We concluded that cortical bone mass in the feet and hands is reduced in severe diabetic neuropathy. This may contribute to the predisposition to metatarsal fracture and diabetic osteopathy.

Osseous lesions of the foot in diabetic neuropathy.

Sandor A. Friedman, M.D., Robert B. Rakow, Pod. D.; Diabetes. 1971; 20: 302 - 7

The clinical course and foot roentgenograms of twenty-two consecutive patients with severe diabetic neuropathy were reviewed. All but one patient had skin breakdown with adequate arterial circulation. Cutaneous lesions responded well to local care, the majority healing within one month, despite widespread bone destruction. In seventeen of the twenty-two cases, (77 per cent), there were multiple bone lesions that tended to be bilateral and to follow the peripheral distribution of the neuropathy. The osseous abnormalities were radiologically indistinguishable from osteomyelitis except for a characteristic thinning of the metaphysis of proximal phalanges. Follow-up X-rays showed progressive bone destruction in four patients although they had no further difficulty with their feet.

We conclude that widespread osteopathy of the foot occurs frequently in severe diabetic peripheral neuropathy and has a better prognosis than osteomyelitis, from which it must be distinguished clinically.

The feet in diabetes.

J. Geoffroy, J.C. Hoeffel, J.P. Pointel, P. Drouin, G. Debry, R. Martin. Roentgenoligic observation in 1501 cases. Diagnostic Imaging. 1979; 48: 286- 93

The manifestations of diabetic osteoarthropathy are described. Computerized analysis of the films of the feet of 1501 diabetic patients showed one or more lesions in 55% of patients. Exostosis (36%), vascular calcifications (25%) and osteoporosis (12.2%) are by far the most frequent symptoms. Geodes (3.7%), destructive lesions (3.9%), sclerosis (4%) and articular lesions (5.1%) are second in frequency. Osteolytic lesions and reconstruction showed a high female predominance, whereas sclerosis is predominant in males (61.6-38.4%).

Value of radiographs and bone scans in determining the need for therapy in diabetic patients with foot ulcers.

Dennis W. Shults, Glenn C. hunter, Kenneth E. Mclntyre, F. Noel parent, Joseph J. Piotrowski, Victor M. Bernhand. The American Journal of Surgery. 1989; 158: 525 –30.

Thirty-two diabetic patients with foot ulcers were evaluated. Twenty-five patients had foot radiographs, technetium-99m bone scans, and wound and bone cultures; the remaining seven patients had all the studies except bone scanning. Bone changes compatible with osteitis were present on 15 of 32 foot radiographs (47 percent) and on 16 of 25 bone scans (64 percent). Bacterial growth was present in 27 of 32 wounds (84 percent) and 23 of 32 bone cultures (72 percent). Twelve of 23 patients (52 percent) with positive bone cultures had evidence of bone destruction and periosteal reaction on radiographs. The remaining 11 of 23 patients (48 percent) without radiographic signs of osteitis had bacterial growth from their bone cultures. Bone scans were positive in 12 of 18 patients (67 percent) with positive bone cultures and negative in 6 of 18 positive bone cultures (33 percent). We conclude that neither foot radiographs, technetium-99m bone scans, nor wound cultures should be used as the sole criterion for determining the use of antibiotic therapy or amputation in diabetic patients with foot ulcers.

The radiological residue of healed diabetic arthropathies.

K. Reinhardt. Skeletal Radiol. 1981; 7: 167- 72.

Diabetic arthropathy is a relatively rare manifestation of neuropathic disease, occurring in fewer than 5% of cases. Abnormalities of this type are confined largely to the small joints of the feet, although the larger joints of the lower limbs and the spine occasionally are affected. Some lesions, particularly in the feet, repair spontaneously, leaving radiological residue sufficiently characteristic to prompt suspicion of an unrecognised diabetic state. These include deformity of the head of the second metatarsal (akin to a

Freiberg lesion), shortening of the great toe, painless deforming arthrosis of the knees, and ankylosis of interphalangeal joints. In the presence of these signs the patients should be interrogated concerning diabetes and blood sugar estimates, with provocation if necessary, obtained. Should such a diagnosis be sustained, appropriate protective measures may be undertaken to avoid a relapse of the arthropathy.

Prevalence and risk factors for diabetes and diabetes– related amputations in American Indians in Southern Arizona.

Robert B, Wirth, Anthony A, Marfin, David W. Grau, Steven D. Helgerson. Diabetes Care. 1993; 16: 354 – 6.

To describe the prevalence of NIDDM and LEA using data from a computer-based patient data base. Diabetic patients with and without LEA, and non-diabetic patients were identified by computer search. Charts of diabetic patients were identified by computer search. Charts of diabetic patients were reviewed for confirmation of diagnosis of diabetes and diabetes related amputation. The diabetic and non-diabetic populations were described, and certain risk factors were identified.

The overall prevalence of NIDDM in this tribe in 1985 - 1986 was 18.3 / 100 adults (≥ 18 yr of age) whereas the prevalence of LEA/100 adults with NIDDM was 10.3%. Females were 1.3 times as likely to have diagnosed diabetes as males (95% CI 1.2 – 1.4), and males with diabetes were 1.4 times more likely to have had LEA than females with diabetes (95% CI 1.1-1.9).

Automated health-care delivery data base used for this tribe can be used to maintain surveillance for diabetes and amputations in diabetic patients. Effective programs to prevent complications of diabetes, such as LEA, in this tribe are urgently needed.

Autonomic function in neuropathic diabetic patients with foot ulceration.

James E. Gilmore, Judith A. Allen, John R. Hayes. Diabetes Care. 1993; 16: 61-7.

The aim of this study to compare peripheral autonomic function in neuropathic diabetic subjects with and without foot ulceration. Measurements were made on 57 diabetic subjects. 35 subjects had evidence of peripheral neuropathy, 14 of these had a history of foot ulceration and 22 subjects had no evidence of peripheral neuropathy. No patient had peripheral vascular disease. Measurements were made of motor and sensory nerve conduction. Autonomic function was investigated by using standard cardiovascular reflex tests and by measuring blood flow variability in the foot. The vasoconstrictor responses to deep breathing and body cooling were measured by using venous occlusion plethysmography.

Peripheral sympathetic function was significantly worse in the DU group. The vasoconstrictor response to deep breathing in the DU group was significantly smaller than the response in the DN group (15.3 ± 2.7 vs. 38 ± 4%, $P < 0.001$). The response to body cooling in the DU group was significantly smaller than the response in the DN group (6.2 ± 3.1 vs. 20.8 ± 3.5%, $P < 0.01$). Tests of cardiac autonomic fuction and measurements of motor and sensory nerve conduction were similar in both neuropathic groups.
Peripheral autonomic neuropathy is associated with the development of foot ulceration in diabetic subjects.

Lower-extremity amputation in diabetic and nondiabetic patients.

Onni I. Siitonen, Leo K. Niskanen, Markku Laasko, Jukka T. Siitonen, Kalevi Pyorala. Diabetes Care. 1993; 16: 16-31.

To study the incidence of LEAs attributable to PVD in diabetic and nondiabetic patients. The age at first amputation, the level of amputation, the number of reamputations, and survival after amputation also were examined in the study populations.

This retrospective study was based on population of 253,000 inhabitants in eastern Finland. All patients with their first LEA performed during the period from 1 January 1978 to 31 December 1984 were identified from the registers of operation theaters in the study area. Furthermore, patient records and death certificates were reviewed. Amputations attibutable to causes other than evident atherosclerotic vascular disease were excluded.

Altogether, 477 patients (85 diabetic men, 127 non-diabetic men, 169 diabetic women and 96 nondiabetic women) were identified. The overall LEA rate was 26.9/100,000 per yr, and the incidence increased strongly with age in both diabetic and non-diabetic patients. The age-adjusted amputation incidence per yr was 349.1/100,000 for diabetic men. 33.9/100,000 for non-diabetic men, 239.1/100,000 for diabetic women, and 1702/100,000 for non-diabetic women. The proportion of peripheral (toe, leg) amputations was markedly higher in diabetic patients who also tended to have more reamputations during the follow-up than did non-diabetic subjects. The diabetic status per se was a statistically significant risk factor for morality in women, but not in men.

Diabetic men and women had a 10.3- fold and 13.8- fold higher risk respectively for LEA.

Role of experimental socks in the care of the high-risk diabetic foot.

Heather J. Murray, Aristids Veves, Matthew J. Young, Douglas H. Richie, Andrew J. M. Boulton. Diabetes Care. 1993; 16:190-2.

To assess the acceptability of specially designed socks to provide satisfactory pressure relief in the insensitive, High-risk, diabetic foot. We have conducted a longitudinal multicenter patient evaluation study to assess the acceptability of such hosiery in neuropathic diabetic patients.

A group of 86 neuropathic diabetic patients (69 males, 14 with type 1 diabetes) with a mean age of 63 yr (range 34-85 yr), and a diabetes duration of 16 yr (range 1-45 yr) participated in the study. Peripheral vascular disease was present in 28 (33%) patients, previous foot ulceration in 39 (44%) patients, and active ulceration was present in 11 (13%) patients. All patients were provided with three pairs of specially designed socks and 80 patients with extra-depth shoes. Evaluation and foot examination were performed at 3 and 6 mo.

Socks were worn for a mean of 6 days/wk (range 1-7 days/wk). Patient satisfaction evaluated at both visits was good or very good in 85%, average in 12%, and poor in 3% of patients. Ten ulcers healed during this period, and seven new ulcers occurred. Intention to continue wearing the socks, most or all of the time, was expressed by 84% of patients.

We conclude that the experimental socks have a high level of patient satisfaction when worn with suitable shoes, and may

be an acceptable and inexpensive addition to existing methods of protecting the high risk insensitive diabetic foot.

Efficacy of the dorsal pedal by pass for limb salvage in diabetic patients: short -term observations.

Pomposelli FB Jr, Jepsen SJ, Gibbons GW, Campbell DR, Freeman DV, Miller A, LoGerfo FW. J.Vasc. Surg 1990;11:45-51

Limbs of diabetic patients with distal tibial disease are frequently considered unreconstructible; however, when studied with intraarterial digital subtraction angiography, the dorsal pedal artery is frequently found to be patent. We have reviewed our recent experience with 96 patients, 94% of whom had diabetes and had 97 by pass placed to the dorsal pedal artery. All procedures were for limb salvage. Superimposed infection was present in 42.3%. In 92 instances where intra-arterial digital subtraction angiography successfully visualized the dorsal pedal artery, 91 bypasses were placed. In 12 other cases where the dorsal pedal artery was not visualized by intra-arterial digital subtraction angiography but audible with the continuous-wave Doppler, bypasses were completed successfully in six. All procedures were performed with vein. Inflow was taken from the femoral artery in 48, popliteal artery in 45, tibial artery in 2, and from a femoral tibial graft in 2. Perioperative morality was 1.92%. Actuarial graft patency, limb salvage, and patient survival were 82%, 87% and 80% respectively at 18 months. We conclude that bypass grafting to the dorsal pedal artery can be reliably performed with acceptable short-term results. An attempt should always be made to visualize the foot vessels angiographically, especially in diabetic patients, so that this valuable option in arterial reconstruction will not be overlooked.

The epidemiology of foot lesions in diabetic patients aged 15-50 years.

Borssen B, Bergenheim T, Lithner F. Diabrtic Med. 1990; 7: 438-44.

All diabetic patients aged 15-50 years (n = 395) in the country of Umea (population 118,500) were invited to have a standardized foot examination and 380 (96%) attended. Three quarters (78%) had type 1 diabetes, 20% type 2 diabetes, and 1% secondary diabetes. They were compared with 100 healthy control subjects. Both type 1 and type 2 diabetic patients had slight or moderate loss of forefoot arches more often than control subjects (57% and 60% vs. 31%, p <.0.001). Callosities were not significantly more common in diabetic patients than in control subjects. Lesions observed on the lower legs and feet of the type 1 and type 2 diabetic patients were Melin's shin spots (33% and 39%), dry feet (33% and 29%), yellow toenails (27% and 31%), purpura (9% and 5%), ulcers (3% and 0%), necrobiosis (3% and 0%) and diabetic osteopathy (2% and 0%). Intermittent claudication was present in 1% and 3%, respectively. Three type 1 diabetic patients had undergone below-knee amputation. Two of the control subjects had Melin's shin spots. With the exception of necrobiosis which was only found in women with type 1 diabetes and Melin's shin spots which were twice as common in diabetic men as women, whether type 1 or type 2, lesions were equally distributed between the sexes. Sensory thresholds for vibration, perception, and pain were significantly elevated in type 1 diabetic patients with dry feet, fallen forefoot arches or hammer toes compared with those without. They were not increased in type 2 diabetic patients or control subjects with these lesions.

Relationship of foot deformity to ulcer location in-patients with diabetes mellitus.

Mueller MJ, Minor SD, Diamond JE, Blair VP. 3d-Phys. Ther. 1990; 70: 356-62.

The purpose of this study was to determine whether a relationship existed between type of foot deformity and the location of ulcers in patients with diabetes and insensitive feet. Forty two ulcerated feet were examined in 40 patients. All patients had severely decreased or absent sensation. Foot deformities were classified according to operational definitions as 1) Charcot's foot, 2) a compensated forefoot varus, or 3) an uncompensated forefoot varus, or forefoot valgus. The planter surface of the midfoot and forefoot was divided into three regions. Six of the 7 patients with a Charcot's foot showed ulceration at the midfoot. Nine of 18 patients with a compensated forefoot varus showed ulceration at the second, third, or fourth metatarsal head. Fifteen of 17 patients with an uncompensated forefoot varus or forefoot valgus showed ulceration at the first or fifth metatarsal. A significant relationship was found between foot deformity and location of ulcer. These results support the hypotheses 1) that insensitivity, coupled with increased, repetitive pressure, is a primary cause of plantar ulcers and 2) that certain foot types plantar ulcers are associated with characteristic patterns of pressure distribution and callus formation.

Metatarsal head resection for diabetic foot ulcers.

Griffiths GD, Wieman T. J. Arch. Surg. 1990; 125: 823-5.

Twenty-five diabetic patients underwent 34 metatarsal head resections for chronic neuropathic ulceration. All ulcers were located on the plantar surface beneath the metatarsophalangeal joints. The ulcers had been present for a mean of 9.0±7.8 months before operation, yet they mean of 2.4±1.6 months postoperatively. None recurred during the mean follow-up time of 13.8±11.0 months. Moderate peripheral vascular disease, impaired renal function, and retinopathy did not affect the time required for ulcer healing. There were two complications: one wound infection and one hematoma. No extremities were lost, and none of the patients suffered any long-term sequelae. We recommend metatarsal head resection to achieve the healing of chronic dibetic foot ulcers under the metatarsophalangeal joints.

Simplified two-stage below-knee amputation for unsalvageable diabetic foot infections.

Kernek CB, Rozzi WB. Clin. Orthop 1990; 261: 251-6.

A simplified two-stage below-knee amputation for unsalvageable diabetic foot infections was done on 19 limbs with 84% good results for healing. The first stage was the standard below-knee amputation with a long posterior flap in which the fascia and skin were closed in the central portion with the medial and lateral portions of the wound left open for drainage. The second stage was delayed until closure of the open wounds 3-7 days after the first stage. Wagner's classification of diabetic foot lesions was used to stratify these cases. Grade 3 and 4 foot infections had a uniformly good prognosis for healing with this surgical technique. Grade 5 foot infections had a poor prognosis for healing, especially if associated with renal failure and dialysis, even with an initial guillotine amputation.

Amputation prevention in an independently reviewed at-risk diabetic population using a comprehensive wound care protocol.

Knighton DR. Fylling CP, Fiegel VD, Cerra F. Am. J. Surg. 1990; 160: 466-72.

An independent review panel composed of an orthopedic surgeon, a vascular surgeon and an endocrinologist was convened to conduct a case history review. The 71 patients reviewed had 124 wounds on 81 limbs and participated in the comprehensive wound management program of the University of Minnesota. Based on their expertise, the review panel classified the wounds by severity and identified the limb's risk for amputation. The resulting scores were then compared with the patient's actual outcome. The review panel predicted 65 (80%) of the limbs would be salvaged and 16 (20%) would be amputated. The actual outcome was that 75 (93%) of the limbs were salvaged and 6 (7%) were amputated ($p < 0.005$). The university's wound management program was highly successful, compared with the predictions of the reviewers.

Topical phenytoin in diabetic foot ulcers.

Muthkumaraswamy MG, Sivakumar G, Manoharan G. Diabetes Care. 1991; 14: 909-11.

The efficacy of topical phenytoin in the treatment of diabetic foot ulcers was evaluated in a controlled in patient study. Fifty patients were treated with topical phenytoin and 50 patients matched for age, sex and ulcer areas, depth chronicity and infection were dressed with a dry sterile occlusive dressing. Both groups improved, but the ulcers treated with topical phenytoin healed more rapidly. Mean time to complete healing was 21 days with phenytoin and 45 days with control. The differences seen were statistically significant ($p < 0.05$) via the ^{2}-test. It is concluded that phenytoin appears to be useful as a topical agent in promoting the healing of diabetic foot ulcers.

The prevalence and nature of podiatric problems in elderly diabetic patients.

Evans SL, Nixon BP, Lee I, Yee D. Mooradian AD. J. Am. Geriatr. Soc. 1991; 39: 241-5.

To determine whether diabetes in the elderly is associated with increased prevalence of podiatric problems, a random sample of diabetic patients (n = 74) was compared to a group of elderly non-diabetic patients (n = 79). The two groups were comparable in age (range 70-90 years), smoking habits and consumption of alcohol. The mean duration of diabetes was 14.5± 11.7 years (± SD) and mean serum fructosamine level was 3.3± 0.66 mmol/l. The number of medical diagnoses and medications used was significantly higher in the diabetic group. Diabetic patients had modestly higher prevalence of neuropathy, vascular disease, kidney disease and eye complications. The most common podiatric problem in both groups was elongated toenails. The prevalence of podriatic problems such as cellulitis, amputation, tinea pedia, onychomycosis, calluses, bunions and hammer toe deformity were not increased in diabetic patients. Active foot ulcers were more common in diabetic patients (13/74 vs 5/79; $p < 0.05$). It is concluded that diabetes in the elderly, unlike in young patients, increases the risk of foot problems only marginally.

Role of non-invasive vascular diagnosis in the study of diabetic foot.

Bronzi G, Orlando D, Venarucci V, D'Alonso L, Bellagamba G, Delle Monache G. Minerva Med. 1991; 82: 119-23

The authors examine the possibilities of instrumental diagnosis in patients with diabetic foot syndrome. The lack of clinical relevance of so-called 'microangiopathy' is stressed because either macroangiopathy or diabetic neuropathy are responsible for almost all the symptoms of this syndrome. In the differential diagnosis between these two major sequelae of diabetes, with consequently wide differences in therapeutic choices, the Doppler ultrasound examination proved to be the most useful because it is very sensitive and specific in detecting and localizing any lesion suggestive of macroangiopathy.

Importance of diabetic foot admissions at Middlemore Hospital.

Thompson C, McWilliams T, Scott D, Simmons D. New Zealand Med. J. 1993; 106:178-80.

To investigate the costs and mortality associated with admission for diabetic foot problems, patients were identified by codes for diabetes and peripheral vascular disease from routinely collected hospital discharge data. Information was collected retrospectively from charts. Postdischarge outcome was assessed by discussion with general practitioners. A total of 357 patients accounted for 503 admissions; 11-15% of patients (n = 49) were admitted for diabetic foot problems. Patients with type-I diabetes had shorter lengths of stay than those with type-II diabetes and were more likely to be admitted with chronic renal failure and less likely to be admitted with ischaemic heart disease. Maori and Pacific Island patients with type-II diabetes were admitted at a younger age than Europeans (53±12, 56±11 and 69±13 years, respectively; $p < 0.001$). Admissions for diabetic foot problems resulted in the longest hospital stay in comparison with other causes (19 [range 1-184] vs. 8 [range 1-116] days). Average cost per diabetic foot admission was $12,500 with a total annual cost of over $600,000. The diabetic foot is expensive, and yet these costs are largely avoidable with improvement in patient education, motivation, monitoring and earlier intervention. It would be better to have in place improved community and hospital care before the predicted growth in the diabetic population associated with ageing.

Survivorship of healed partial foot amputations in dysvascular patients.

Santi MD, Thoma BJ, Chambers RB. Clin. Orthop, Relat. Res. 1993; 292: 245-9.

The results of 94 initially successful, partial foot amputations in dysvascular patients were reviewed, with survivorship analysis at a minimum of 6.5 years after surgery. Partial foot amputations were divided into three types: Transmetatarsal amputations, metatarsophalangeal disarticulations and ray resections. No amputation type was more or less likely to be treated with subsequent amputation of the foot or to develop recurrent ulceration. Taking all groups together, the chance of retaining the foot after an initially healed partial foot amputation was 86% at 4 years after surgery and 76% at 8 years after the operation. Of these surviving feet, however, 53.8% developed ulceration or needed local reoperation. The chance of completely avoiding any surgery after an initially healed partial foot amputation was 71% at 4 years after surgery and 52% at 8 years after the operation. In properly

selected patients, partial foot amputations have significant longevity.

High prevalence of diabetes in chronic leg ulcer patients: a cross sectional population study.

Nelzen O, Bergqvist D, Lindhagen A. Diabetic Med. 1993; 10: 345-50.

In cross-sectional survey designed to detect all patients with current chronic leg ulcers, 27% of the patients had diabetes mellitus. The outcome for 104 examined diabetic patients was evaluated and compared with the 278 non-diabetic patients. The purpose was to establish the prevalence of leg ulcers among diabetic patients and to assess potential causes. The point prevalence was calculated by extrapolating the leg ulcer frequency to the total diabetic population in the studied area. The point prevalence for active leg ulcers (including foot ulcers) in diabetic patients was 3.5% (95% CI 2.8-4.2%). Ulcers above the malleoli were almost as common as foot ulcers. Peripheral vascular disease was present in 67% of all ulcerated legs in patients with diabetes compared to 42% in non-diabetic patients ($p < 0.001$). In 72% of foot ulcers in diabetic patients, arterial impairment was judged to be a contributing aetiological factor, as was the case in 45% of foot ulcers in non-diabetic patients ($p < 0.001$). Ulcers solely attributed to possible neuropathy were less common (15%). Ulcers with multifactorial causes were common above the malleole. This survey has given the size of the problem and indicates macroangiopathy to be the dominating factor responsible for slow or non-healing ulcers in diabetic patients. Objective assessment of arterial circulation is mandatory, and signs of arterial impairment require consultation with a vascular surgeon.

Reduction of lower extremity clinical abnormalities in patients with NIDDM. A randomized, controlled trial.

Litzelman DK, Slemenda CW, Langefeld CD, Hays LM, Welch MA, Bild DE, Ford ES, Vinicor F. Ann. Intern. Med. 1993; 119: 36-41.

The objective of this blinded, randomized, controlled trial carried out in an academic general medicine practice was to evaluate the effect of patient, health care provider and system intervention on the prevalence of risk factors for lower extremity amputation in patients with NIDDM. Of the 395 patients with NIDDM who underwent the initial patient assessment, 352 completed the study. The 12-month intervention was multifaceted. Patients received foot care education and entered into a behavioral contract for desired self foot care, which was reinforced through telephone and postcard reminders. Health care providers were given practice guidelines and informational flow sheets on foot-related risk factors for amputation in diabetic patients. In addition, the folders for intervention patients had special identifiers that prompted health care providers to ask that patients remove their footwear, to perform foot examinations and to provide foot care education. Patients receiving the intervention were less likely than control patients to have serious foot lesions (baseline prevalence 2.9%; odd ratios 0.41 [95% CI 0.16-1.00]; p=0.05) and other dermatologic abnormalities. Also, they were more likely to report appropriate self-foot care behaviors, to have foot examinations during office visits (68% compared with 28%; $p < 0.001$) and to receive foot care education from health care providers (42% compared with 18%; $p< 0.001$). Physicians assigned to intervention patients were more likely than physicians assigned to control patients to examine patients' feet for ulcers, pulses and abnormal dermatologic conditions and to refer patients to the podiatry clinic (10.6% compared with 5.0%; p=0.04). An intervention designed to reduce risk factors for lower extremity amputations positively affected patient self-foot care behavior as well as the foot care given by health care providers and reduced the prevalence of lower extremity clinical disease in patients with diabetes.

Lower extremity amputation. Incidence, risk factor and mortality in the Oklahoma Indian diabetes study.

Lee JS, Lu M, LEE VS, Russell D, Bahr C, Lee ET. Diabetes. 1993; 42: 876-82.

Oklahoma Indians with NIDDM (n = 1012) underwent a baseline examination in 1972-1980.The incidence of, and risk factors for, first lower extremity amputation (LEA) were estimated. The mortality rates of amputees using data from 875 patients who had no previous history of amputation and who underwent follow-up examination between 1987 and 1991 are presented. The mean age of the 875 patients was 51.6 $\pm$ 10.8 years, and the mean duration of diabetes was 6.6 $\pm$ 6.1 years. After a mean follow-up time of 9.9 $\pm$ 4.3 years, the incidence rate of first LEA among diabetic Oklahoma Indians was 18.0 / 1000 person years. The incidence rate was two times higher in men than in women. In both sexes, significant risk factors ($p < 0.05$) were retinopathy and duration of diabetes. Fasting plasma glucose, use of insulin and systolic blood pressure were significant for men only. For women, plasma cholesterol and diastolic blood pressure were additional risk factors. Compared with the mortality rate of 33.5 / 1000 person years among non-amputees, the rate among amputees was 55.5/1000 person years. The 5-year survival rate after first amputation was 40.4%. For the amputees, the most common causes of death were diabetes (37.3%), cardiovascular disease (29.1%) and renal disease (7.3%). The incidence and mortality rates in diabetic Oklahoma Indians were higher than those reported in Pima Indians and other diabetic populations. To lower the incidence of LEA in this high-risk population, preventive action through education, foot care programs and early detection of lesions must be intensified.

Outpatient treatment of unilateral diabetic foot ulcers with 'half shoes'.

Chantelau E, Breuer U, Leisch AC, Tanudjaja T, Reuter M.Diabetic Med.1993; 10 267-70

The impact of 'half shoes' in the treatment of neuropathic forefoot ulcers was studied in two groups of diabetic patients who were treated either by standard treatment alone (retrospective controls, n = 22) or by standard treatment plus 'half shoes' (cases, n = 26). The groups were matched for sex, age, type and duration of diabetes and ulcer grading. The 'half shoe' cases vs 'controls' median overall healing time was 70 vs. 118 days, the median difference being 48 days (95% CI – 5 to 82) (ns). In the case group, hospitalization was required in 1/26 (4%) of patients vs. 9/22 (41%) of the control patients X^2; $p < 0.01$). The home nursing service was required in 23% of the cases vs 18% of the controls (ns). It is concluded that the use of half shoes, in conjunction with standard treatment provided by a specialized diabetic foot clinic, may reduce the overall healing time and does reduce the hospitalization rate. This has implications for a rational strategy of treating unilateral diabetic neuropathic foot ulcers.

The effect of callus removal on dynamic plantar foot pressures in diabetic patients.

Young MJ, Cavanagh PR, Thomas G, Johnson MM, Murray H, Boulton AJ. Diabetic Med.1992; 9: 55-7.

Clinical observation suggests that neuropathic foot ulceration frequently occurs beneath plantar callosities and in areas of high dynamic shear and vertical stress underneath the foot during walking. Seventeen diabetic patients had dynamic foot pressure measurements made before and after the removal of a total of 43 forefoot plantar callosities. Peak pressures (mean ± SE) in the treated areas were reduced by 26% from 14.2± 1.0 to 10.3± 0.9 kg cm^{-2} ($p < 0.001$), with reductions at 37 of the 43 sites and in all patients. Mean heel pressures were not significantly different (5.0± 0.6 vs. 4.9± 0.6 kg cm^{-2}). These results suggest that callus may act as a foreign body elevating plantar pressures and that a significant reduction in pressure is achieved by local chiropody treatment.

Diabetic foot care. Financial implications and practice guidelines

Reiber GE. Diabetes Care. 1992; 5: 29-31.

Foot problems are common in the 12 million diagnosed and undiagnosed United States diabetic subjects and result in extensive hospitalization, disfiguring surgery, lifetime disability and a diminished quality of life. The unequivocal nature of a lower extremity amputation makes this the best defined and monitored of the diabetic foot problems. United States hospital discharge data from 1980-1987 indicated that amputation rates increased with advancing age and were higher in blacks than whites and men than women. Foot pathology has been reported as the most common complication of diabetes leading to hospitalization. Economic considerations extend beyond direct cost estimates based on numbers of affected individuals and the cost and duration of patient care. Indirect cost estimates describing lost economic productivity because of related illness, disability and premature death are needed. Multidisciplinary team approaches to diabetic foot care have reported statistically significant prepost program reductions in morbidity and cost. Regardless of the care setting and the availability of the foot care teams, diabetic foot care guidelines should be viewed by providers as recommended minimum practice levels to be adapted according to the patient's pathology, comorbidity and abilities. Although guidelines specify minimum acceptable practice levels, they are not intended to set a ceiling on professional excellence.

Paradoxical blood flow responses in the diabetic neuropathic foot: an assessment of the contribution of vascular denervation and microangiopathy.

Stevens MJ, Edmonds ME, Foster AV, Douglas SL, Watkins PJ. Diabetic Med. 1992; 9: 49-54.

Blood flow is abnormal in the diabetic neuropathic foot and this may be of importance in the pathogenesis of complications. Arteriovenous shunting is increased and blood flow through these channels may paradoxically decrease in response to local heating. Peak skin blood flow is also reduced in these patients. It is not known whether these blood flow abnormalities may reflect diabetic microangiopathy or whether they simply reflect vascular denervation. The skin-blood flow response to a local thermal stimulus was studied in four non-diabetic patients with a unilateral traumatic neuropathy and foot ulceration. All showed a decrease in skin blood flow (to 68% of basal) at the great toe during local heating in the neuropathic limb, in contrast to the normal limb, in which blood flow increased to 180% of basal. Peak skin blood flow was also greatly reduced in the neuropathic limb, being only 29% of the normal limb. Neuropathy alone can be responsible for abnormal skin flow responses in the neuropathic foot.

Bacteriology of 100 consecutive diabetic foot infections and in vitro susceptibility to ampicillin/sulbactam vs cefoxitin.

Borrero E; Rossini M. Jr. Angiology. 1992; 43: 357-61.

One of the major complications of diabetes mellitus is the occurrence of diabetic foot infection. The polymicrobial nature of diabetic foot infection has been well documented in the literature. In order to avoid amputation of the tissue affected, the ulceration and infection must be appropriately diagnosed and treated. This paper describes the microbiologic and clinical features obtained from 100 consecutive diabetic infected foot patients treated with either with cefoxitin or ampicillin/sulbactam.

Nocturnal subcutaneous hyperaemia in the lower leg and foot of type-I diabetic patients.

Kastrup J, Sindrup JH, Christiansen E, Jelnes R, Wroblewski H, Norgaard T, Parving HH. Diabetic Med. 1992; 9 : 38-43.

Nocturnal fluctuations in subcutaneous blood flow in the lower leg and foot were measured during sleep in type-I diabetic patients without autonomic neuropathy. Subcutaneous blood flow was measured, simultaneously, 100 mm above the malleolus on the medial aspect of the right lower leg and at the dorsum of the left foot in 10 diabetic patients and on the right lower leg only in 10 normal human subjects over 12-20 hours. The ^{133}Xe washout technique, portable CdTe (CI) detectors and a portable data storage unit were used. The tracer depots were applied by means of the epicutaneous, atraumatic labelling technique. In diabetic patients, subcutaneous blood flow increased 102± 63% in the lower leg and 111± 98% in the foot at 113± 32 minutes and 107± 37 minutes after going to sleep. The hyperaemic phase lasted 128± 43 minutes and 150± 42 minutes, respectively. The hyperaemic response was not different from that in the control subjects (89± 61%). There was no significant correlation between the absolute hyperaemia in the leg and that in the foot. In conclusion, type-I diabetic patients without autonomic neuropathy have normal nocturnal hyperaemia during sleep.

Effect of total contact cast immobilization on subtalar and talocrural joint motion in- patients with diabetes mellitus.

Diamond JE, Mueller MJ, Delitto A. Department of Phys. Ther. 1993; 73: 310-5.

The purpose of the study was to determine the effect of total contact casting (TCC) on dorsiflexion at the talocrural joint and motion (inversion/eversion) at the subtalar joint (STJ). Thirty-seven patients (29men and eight women), ranging in age from 32 to 79 years (mean 54± 11), with diabetes mellitus and a unilateral plantar ulceration participated in the study. The subjects were measured with a goniometer for dorsiflexion and STJ range of motion (ROM). The ROMs for each subject's casted and non casted leg were compared before and after treatment with TCC for neuropathic plantar ulcers by use of a 2x2 repeated-measure analysis of variance design. The mean time of immobilization in TCC (healing

time) was 42±43 days (range 8-119). The results indicated that ROM was unchanged at the STJ, but dorsiflexion decreased slightly (1°) on both the casted and non-casted sides following the last cast removal and the ROM was less on the ulcerated side prior to casting compared with the non-ulcerated side. The authors believe that the beneficial effects (decreased dorsiflexion) of treatment with TCC.

Foot infections in diabetes: the antibiotic choice.

Asfar SK, al Arouj M, al Nakhi A, Baraka A, Juma T, Johny M. Can. J. Surg. 1993; 36: 170-2.

The authors studied 59 diabetics with foot infections to determine the organisms responsible and the sensitivity to antibiotics. All infections were polymicrobial (aerobic and anaerobic). On average, 3.2 isolates per culture were obtained from the depth of infection. The most common organisms in order of frequency were : Staphylococcus aureus, beta-hemolytic streptococci, Proteus sp., Bacteroides sp., Enterococci, Klebsiella sp. and Pseudomonas aeruginosa. A combination of piperacillin and cloxacillin is recommended as initial therapy for foot infection in diabetic patients because it was found to be effective for 73% of the causative micro-organisms.

Ethnic differences in the incidence of lower extremity amputation secondary to diabetes mellitus.

Gujral JS, McNally PG, O'Malley BP, Burden AC. Diabetic Med. 1993; 10: 271-4.

Patients of Asian ethnic origin with diabetes mellitus living in the UK have been shown to have a higher prevalence of coronary heart disease and renal disease. Little is known about the incidence of lower extremity amputation in this racial group. The incidence of lower extremity amputation was estimated for patients of Asian ethnic origin and white Caucasians with diabetes mellitus in the country of Leicestershire from 1980 to 1985. The age and sex-adjusted incidence rate of lower extremity amputation for the estimated population of patients with diabetes mellitus in those of Asian ethnic origin was 3.4(95% CI 1.1-10.7) cases per 10,000 patients $year^{-1}$ compared to 14.2(12.6-15.9) in White Caucasians. Similarly, a lower incidence rate of lower extremity amputation was recorded in patients of Asian ethnic origin without diabetes mellitus (0.4 [02 - 0.6] vs 1.5 [1.4 -1.6] cases per 10,000 persons-$year^{-1}$.) These findings contrast markedly with the high rates of coronary heart disease and renal disease previously reported in patients of Asian ethnic origin residing in the UK.

Improved quality of diabetic foot care: 1984 vs 1990. Reduced length of stay and costs: insufficient reimbursement

Gibbons GW, Marcaccio Jr EJ, Burgess AM, Pomposelli Jr.FB, Freeman DV, Campbell DR, Miller A, LoGerfo FW. Arch.Surg 1993; 128: 576-81

Ischemic foot ulceration in the diabetic patient is a source of great physical and emotional strain for the patient and represents a significant financial burden for the health care system responsible for the cost of such care. Limb salvage remains the primary therapeutic goal; yet, fiscal constraints imposed by diagnosis-related group-based reimbursement systems require maximal cost efficiency in the care process. Between 1984 and 1990, the changes in the authors' team management approach to this problem, emphasizing aggressive surgical revascularization of threatened limbs, improved the quality of care and dramatically reduced the major and minor amputation rate. In the process, both the length of hospital stay and the overall cost of care were reduced. Despite this improvement in outcome and efficiency, Medicare reimbursement remains insufficient, with an average loss of $7480 per admission.