

# Amputation of the forefoot

## Predictive value of signs and clinical physiological tests

Fifty-two transtatarsal and 11 transtarsal forefoot amputations were reviewed. Primary healing was obtained in ¼ of the amputations. No difference could be detected between diabetic and non-diabetic gangrene regarding wound healing. The local blood pressure at the ankle had a useful predictive value, whereas the blood pressure at the toe level was of no value. Skin perfusion pressure was impossible to measure in several cases and was thus of less value, as was the clinical judgement.

*Key words:* amputation; blood pressure; diabetes mellitus; foot; gangrene; wound healing.

**Michel E. H. Boeckstyns & Claus Munk Jensen**

Department of Orthopedic Surgery, University of Copenhagen Hospital in Hvidovre, Denmark

While forefoot amputation allows good function, wound healing is often a problem. The purpose of this retrospective study was to evaluate the influence of selected preoperative information (anamnestic data, clinical signs, local blood pressure (LBP) and skin perfusion pressure (SPP)) on wound healing.

### Patients and methods

Between 1976 and 1981, 63 forefoot amputations had been performed on 62 patients at the Department of Orthopedic Surgery, at Hvidovre Hospital: 52 transtatarsal and 11 transtarsal. The age of the patients, at the time of surgery, averaged 70 (41-91) years. The indication was manifest ischaemia, defined as gangrene or ulceration, or painful cyanosis/lividity. Twenty-nine cases were associated with diabetes, 14 being treated with peroral antidiabetics or dietary restrictions alone, 15 being treated with insulin. Two were associated with polycythaemia vera, one with polycythaemia vera and polyarteritis nodosa, and one was caused by ergotamine poisoning.

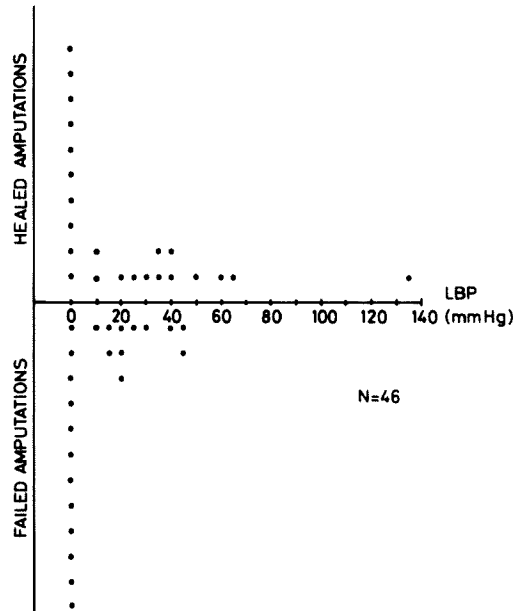


Figure 2. Correlation of toe LBP and rate of success.

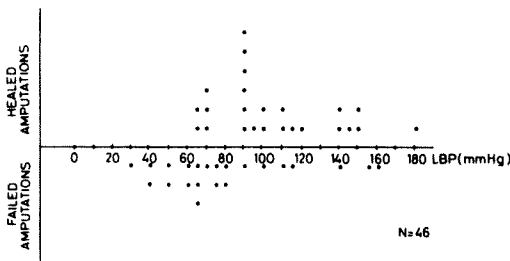


Figure 1. Correlation of ankle LBP and rate of success.

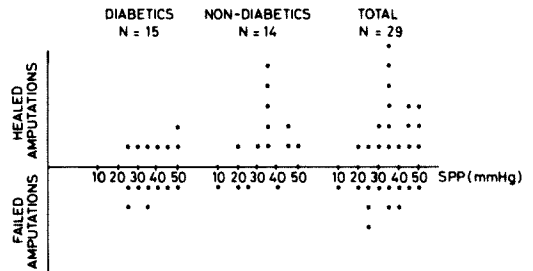


Figure 3. Correlation of SPP on the dorsum of the foot and rate of success.

Selection of the level of amputation was based on clinical judgement and peroperative evaluation of bleeding. Forefoot amputation was not considered if LBP at the ankle was below 40 mm Hg.

LBP (i.e. the systolic blood pressure at a given level of the extremity) was measured with the strain-gauge technique (Lassen et al. 1975), and SSP according to the principles described by Holstein et al. (1977). The radioactive agent used was  $^{99m}\text{Tc}$ -pertechnetate.

The amputations were performed in general anaesthesia. A long plantar and a short dorsal flap were fashioned and the wound was sutured. One case was primarily left open and sutured after secondary revision. Peroperative antibiotic treatment was given to 52 patients and in uncomplicated cases continued for 3 to 4 days (methicillin 1 g 4 times daily, or modified according to preoperative bacterial cultures). Weight-bearing was first allowed when wound healing was achieved.

The amputations were rated as successful only in those cases in which wound healing was obtained and reamputation was avoided during the first postoperative year.

## Statistics

Statistical analysis included two-tailed Mann-Whitney U-tests and chi-square tests.

## Results

Primary wound healing was obtained in 17 of the 63 amputations. In the others, the course of healing was protracted: 20 out of 60 wounds had healed after 3 months, and 29 out of 55 after 6 months. There was no significant difference between diabetics and non-diabetics. One year after operation, 25 patients had been reamputated at an above-ankle level. Among the remaining patients, 27 had healed at a below-ankle level, 10 had died and in one case no sufficient information was available. The three patients with polycythaemia vera had died and thus they did not influence the final evaluation.

Of the clinical signs, only the presence of a palpable pulse on the dorsum of the foot had a significant influence on the final rate of success ( $p < 0.05$ ). However, it did not influence the rate of primary healing. Previous amputation on either extremity, the presence of diabetes, the number of gangrenous toes, the duration of the gangrene and its appearance ("wet" or "dry") had no influence.

The rate of success, but not the rate of primary healing, correlated significantly to the LBP measured at the ankle level ( $p < 0.005$ , Figure 1). Both in diabetics and in non-diabetics, ankle LBP-values lower than 60 mm Hg were not compatible with success.

LBP at the toe level correlated badly to the rate of success (Figure 2). Thus, the correlation between the LBP-gradient (ankle-LBP - toe-LBP) and successful amputation was less pronounced than was the case with LBP at the ankle, but it was still significant ( $p < 0.05$ ).

The correlation between SSP and the rate of success was not significant in either group (Figure 3).

## Discussion

Clinical judgement alone has limited sensitivity and specificity in predicting success following forefoot amputation (Rosendahl 1972, Effeney et al. 1977, Young 1979, Larsson & Andersson 1978, Mehta et al. 1980). Several authors have reported fair wound healing rates with ankle LBP-values higher than 60–70 mm Hg, determined by the Doppler ultrasonic method (Verta et al. 1976, Baker & Barnes 1977, Mehta et al. 1980). In the present study, measuring the LBP at the ankle level proved superior to measuring at the toe level, although falsely high values may be obtained in patients with calcified non-compressible vessels (media sclerosis).

SSP-determination on the dorsum of the foot seems to be less reliable and could not be performed at all in several cases: in the presence of oedema, increasing the external pressure results in a decrease of radioactivity, even when vascular wash-out has ceased.

## References

- Baker, W. H. & Barnes, R. W. (1977) Minor forefoot amputation in patients with low ankle pressure. *Am. J. Surg.* **133**, 331–332.
- Effeney, D. J., Lim, R. C. & Schecter, W. P. (1977) Transmetatarsal amputation. *Arch. Surg.* **112**, 1366–1370.

- Holstein, P., Lund, P., Larsen, B. & Shoemaker, T. (1977) Skin perfusion pressure measured as the external pressure required to stop isotope washout. Methodological considerations and normal values of the legs. *Scand. J. Clin. Lab. Invest.* **37**, 649–659.
- Larsson, U. & Andersson, G. B. J. (1978) Partial amputation of the foot for diabetic or arteriosclerotic gangrene. *J. Bone Joint Surg.* **60-B**, 126–130.
- Lassen, N. A., Jeppesen, F. I., Nielsen, P. E., Holstein, P., Nielsen, S. L. & Tønnesen, K. H. (1975) Strain-gauge måling af distale blodtryk ved okklusive arterielidelser. *Ugeskr. Læg.* **137**, 365–369.
- Mehta, K., Hobson II, R. W., Jamil, Z., Hart, L. & O'Donnell, J. A. (1980) Fallibility of Doppler ankle pressure in predicting healing of transmetatarsal amputation. *J. Surg. Res.* **28**, 466–470.
- Rosendahl, S. (1972) Transmetatarsal amputation in diabetic gangrene. *Acta Orthop. Scand.* **43**, 78–83.
- Verta, M. J., Gross, W. S., van Bellen, B., Yao, J. S. T. & Bergan, J. J. (1976) Forefoot perfusion pressure and minor amputation for gangrene. *Surgery* **80**, 729–733.
- Young, A. E. (1979) Transmetatarsal amputation in the management of peripheral ischaemia. *Am. J. Surg.* **134**, 604–607.