ASPECTS OF TREATMENT*

A modified Gritti–Stokes amputation: its place in the management of peripheral vascular disease

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Key words: VASCULAR DISEASE; AMPUTATION; PROSTHESIS

Summary
A modified technique for performing the Gritti–Stokes amputation is described and the results obtained in 247 cases are presented. The mortality rate was 9.3% and healing occurred in 87% of survivors. Using this modified technique the frequently cited criticisms of non-union of the patella and painful stumps were not found to be major problems. The prosthetic problems of amputation at this level are discussed in relation to recent developments in the design of artificial limbs.

Introduction
In recent years advances in materials and techniques in reconstructive vascular surgery have greatly improved the prospects of patients with peripheral vascular disease in both the claudicant and limb salvage groups. Many patients who would formerly have undergone early amputation can now look forward to retaining a useful limb for many years.

Sometimes, however, the initial improvement attained immediately after operative treatment is not maintained, and many of these limbs, together with a group initially deemed unsuitable for reconstructive surgery, eventually come to amputation.

At this stage the surgeon must decide at which level the limb is to be amputated. There is general agreement that the knee joint should be preserved if at all possible as the below-knee amputee has excellent prospects of return to full mobility (1,2). Frequently, however, amputation at this level is inappropriate and a higher level has to be chosen. The options then available are the standard above-knee amputation, disarticulation through the knee, or the controversial Gritti–Stokes procedure.

Gritti first described his amputation in 1857, whilst working in Milan, but he only performed it once, and then on a corpse. The operation was modified and performed successfully on a number of patients by Stokes in 1870 but has never gained widespread acceptance as an amputation of choice for ischaemia. Indeed, its use has been strongly condemned by some surgeons (2,3) and limb fitters (4), although other authors take the opposite view and recommend its routine use (5,6).

Criticism of the amputation, centres on three problems, namely non-union of the patella, painful stump and difficulties in fitting a satisfactory prosthesis. It is against this background that we present the results of 247 successive Gritti–Stokes amputations, performed in Nottingham between 1970 and 1980.

Operative technique
The technique used follows that described by Martin and his colleagues (6) with certain important modifications. The femur is transected at supracondylar level instead of trancondylar level, leaving a cross-sectional area roughly equivalent to that of the back of the patella. The angle of cut is such that the sawn surface slopes upward and backward from the anterior aspect. This leads to a mechanically sounder situation than the traditional right angle cut and the patella is much less likely to slip forward. The quadriceps muscles actually pull the patella more firmly onto the cut end of the femur (Fig. 1). Following removal of its articular surface the patella is secured to the lower end of the femur by means of absorbable sutures passed through the joint capsule and the soft tissues behind the femur. There is no fixation through the bone itself. Suction drains are used and the skin is closed separately.

All patients receive prophylactic benzyl-penicillin.

FIG. 1 Showing the line of cut in the femur.
Patients
Between 1970 and 1980, 247 Gritti-Stokes amputations were performed for vascular disease on 217 patients in Nottingham General and University Hospitals. The average age was 69.6 years (range 41–94) years. There were 159 (73%) males and 58 (27%) females, the proportion of females increasing steadily over the ten year period.

The indications for amputation were rest pain (95 cases), gangrene (136 cases) and failure of a below knee amputation to heal (16 cases).

It must be emphasized that the Gritti-Stokes amputations were performed as an alternative to the mid-thigh amputation in cases where it was thought that a below knee amputation would fail to heal or where the presence of a fixed-flexion deformity of the knee rendered a low amputation inappropriate.

Results
Twenty-three patients died within 14 days of operation—an operative mortality of 9.3%. This left 224 stumps in the surviving 194 patients. Primary healing, that is within 21 days, occurred in 144 (64%) cases whilst a further 52 stumps (23%) healed eventually, after a delay of up to 300 days. Thus an overall healing rate of 87% was achieved.

Twenty (9%) patients underwent a subsequent mid-thigh amputation after the original Gritti-Stokes stump had failed to heal or had broken down. In eight patients the stump was unhealed at the time of death.

There were 30 bilateral amputees, the interval between amputations varying from 31–1752 days (mean 540). Healing of the second stump occurred in 26 cases (84%).

The late mortality following amputation confirms the depressing findings of other workers, the five year survival in this series being only 22%.

Problems with the healed stump were not common. Eight patients complained of stump tenderness but in only three was it a major problem. Even these were able to use their prosthesis for short periods. Whilst non-union of the patella undoubtedly does occur, it has been largely asymptomatic, and its true incidence is difficult to assess. In none of our patients did excessive mobility of the patella prevent limb-fitting.

All but 34 of the surviving patients with healed stumps were referred for limb fitting to the Nottingham Artificial Limb and Appliance Centre. Three major types of prosthesis have been used. The standard No 6 metal prosthesis was extensively used in the earlier years but has been largely superseded by the cosmetically more acceptable No 2 Modular Assembly Prosthesis (Chas. A. Blatchford & Sons, Birmingham). In recent months the Hangar 4 Bar Linkage Metal Knee Prosthesis has been successfully fitted to a small number of patients. A few patients have preferred to continue using the pylon leg supplied in the interim before the definitive leg was available.

After limb fitting and variable periods of walking training, mobility of the patient was assessed and graded by the Physiotherapy Department. Of the 194 survivors, 112 (58%) used their limb regularly. Eighteen (9.3%) returned to full employment. Forty patients, of whom 18 were bilateral amputees, were confined to wheelchairs.

Discussion
In our practice the modified Gritti-Stokes amputation has been performed where we thought a below-knee amputation would fail. Thus it has taken the place of the more traditional mid-thigh amputation and in some cases has been performed in preference to a through-knee amputation. If such a policy is to be justified the results must be compared with those obtained when these alternative techniques are used.

Our operative mortality was 9.3%, which is similar to that reported by others for this procedure (3, 6, 7). A mortality of 14% is quoted for through knee amputation (8) while the mid-thigh amputation is generally found to carry a higher mortality varying from 22 to 42% (9, 10, 11). The healing rate in our series was 87% for through-knee amputations; healing rates vary from 78 to 83% (8, 12) and for mid-thigh amputations from 84 to 95% (10, 13). Thus it is confirmed that Gritti-Stokes amputations compare well with the alternatives when operative mortality and healing rates are studied. In particular, it is our opinion that the excessively high mortality generally associated with mid-thigh amputation should mitigate heavily against its routine use.

We also believe that the Gritti-Stokes amputation has another advantage over the mid-thigh amputation. Ironically, the long stump, to which it has proved so difficult to fit a satisfactory prosthesis, becomes a positive advantage to the bilateral amputee. The extra weight and leverage inherent in the long stump allow the bilateral amputee to sit up in bed and turn over unaided, and this extra mobility and independence can be a vital factor in both the physical and psychological rehabilitation of the patient.

With these clear advantages, it is surprising that the Gritti-Stokes amputation is not more widely performed. Part of the bad reputation enjoyed by this procedure has arisen from the complication of painful non-union of the patella (2) but this has not occurred to any significant extent in our patients. We feel that the reason for this is the method we have employed for fixation of the patella. The slope of the cut of the femur coupled with the slightly higher level of bone section lend inherent stability to the patella, whilst the use of absorbable sutures through soft tissue in place of screws or bone sutures reduces the incidence of postoperative infection.

However the major criticism of the Gritti-Stokes amputation has been the difficulties of fitting a sophisticated prosthesis (2, 4). While the standard No 6 prosthesis has provided satisfactory service to many amputees, it has to be

![Fig. 2](image-url) The standard No 6 prosthesis for the Gritti-Stokes Amputation.
admitted that it does have several serious shortcomings. The knee joint is housed on the outside of the prosthesis which in consequence is bulky and ugly (Fig. 2). This makes it unacceptable to many patients, particularly ladies. In addition there is no facility for incorporating an automatic swing phase to the leg. The same prosthetic difficulties are encountered with the through knee amputation where the prosthetist is given no alternative to the provision of an external knee joint. However recent developments in the manufacture of artificial limbs have led to significant improvements in the prostheses that can be fitted to the Gritti–Stokes amputation stump.

The No 2 Modular Assembly Prosthesis (Fig. 3) represents a considerable cosmetic advance over the standard No 6 prosthesis and the use of a short knee chassis enables the knee joint to be housed within the leg. An even more exciting new development is the Hangar 4 Bar Metal Knee which combines the cosmetic advantages of the Modular Assembly Prosthesis with an ingenious mechanism allowing the knee joint to be housed partly within the prosthetic shin, leaving only 20 mm between the end of the stump and the point of flexion of the knee (Fig. 4). An automatic swing phase is also available. This limb has yet to be fully evaluated but the initial response has been encouraging.

In conclusion it can be seen that the Gritti–Stokes amputation offers a low operative mortality and good healing. If the technique is modified as we have suggested it is unlikely that there will be problems with the patella, and the prosthetist is provided with sufficient space to insert sophisticated internal knee joints. Our results suggest that if a below-knee amputation is not possible, the Gritti–Stokes amputation should be preferred to the mid-thigh or through-knee amputations.

References