

## THROUGH-KNEE AMPUTATIONS

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The operative technique of through-knee amputations is described. In a retrospective series of 71 patients re-amputation at the above-knee level was performed in 18 per cent of the cases. Prosthetic gait was achieved in 97 per cent of patients discharged to their own home with preserved level of amputation.

Through-knee amputation is preferable to amputation above the knee and should even be considered as an alternative to below-knee amputation in patients with borderline skin perfusion blood pressure and in feeble patients with poor balance.

*Key words:* amputations; prosthetics; rehabilitation

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The levels of choice for amputations in most geriatric patients are below-knee, through-knee or above-knee. Preservation of the knee joint is usually advocated. In spite of fairly optimistic reports (Batch et al. 1954, Early 1968, Baumgartner 1979, Howard et al. 1969, Newcombe & Marcuson 1972) the through-knee or knee disarticulation procedure has gained only limited attention, although described in recent textbooks (Murdoch 1970, Vitali et al. 1978).

The through-knee amputation technique has been preferred to the above-knee level at our clinic and the following presentation will describe our findings.

### OPERATIVE TECHNIQUE

The level of amputation was determined by clinical evaluation of the ischaemic leg in combination with measurement of the skin perfusion blood pressure with the isotope tracer technique (Holstein & Lassen 1973, Holstein et al. 1979a, b). The skin perfusion pressure was recorded 10 cm distal to the knee joint. A pressure of 30-40 mmHg was considered sufficient. However, in the event of incipient gangrene of the contralateral limb a through-knee amputation was performed at skin perfusion pressure levels of 20-30 mmHg in an attempt to gain length of the affected limb.

The operative technique was in accordance with the procedure described by Kjølbye (1970), utilizing side flaps.

With the patient in a supine position a circular skin incision is performed 3 cm below the tibial tuberosity, corresponding to 8-10 cm below the knee level. The patellar tendon, hamstrings and collateral ligaments are released from their insertions on the shank. The knee capsule is transected medially, anteriorly and laterally distal to the menisci and the cruciate ligaments released from the tibial eminence.

The knee is flexed maximally and the strong posterior knee capsule released from the tibia, followed by division of the gastrocnemius heads 3 cm below knee level to preserve the blood supply from the superior genicular artery.

The vessels are divided at knee level, and the tibial and peroneal nerves gently pulled down, ligated and divided.

The menisci are removed, but no synovectomy and no bone surgery is performed.

The apex patellae is positioned level with the femoral condyles and the patellar tendon sutured to the cruciate ligaments, thus creating a triangular shape of the stump end. The hamstrings and posterior capsule are also sutured to the cruciate ligaments and capsular tissue.

A subcutaneous suction drain is applied. The skin is trimmed as side flaps and sutured with interrupted stitches, leaving the scar dorsally between the femoral condyles. Care should be taken to avoid skin tension at the suture line and especially over the prominent medial femoral condyle.

Postoperatively the stump is dressed with an elastic or plaster of Paris bandage. Wound healing can be expected after 3 weeks and prosthetic fitting is started shortly after.

## PATIENTS AND METHODS

During the period 1971 to 1979, a through-knee amputation was performed in 22 per cent (71/330) of the major lower limb amputations undertaken (Table 1). The through-knee amputation was the primary procedure in 68 cases, whereas three were performed after failed below-knee amputations. A further four patients with failed below-knee amputations were not included, as wound infection and necrosis appeared in close relation to the knee disarticulation.

The cause of amputation was gangrene due to arteriosclerotic vascular disease alone in 83 per cent (59/71) of the cases, whereas the remainder were complicated by diabetes mellitus.

The average age of the patients was 72 years (range 38–92), 24 per cent (17/71) being above 80 years of age. Two-thirds (46/71) were males (Table 2).

The majority of the patients were admitted from their own home, but 18 per cent (13/71) were referred from a nursing home.

Postoperatively the patients were trained in hospital until satisfactory walking ability was achieved and the prosthesis could be finished. The patients were followed up as outpatients and the result of rehabilitation recorded about 6 months postoperatively. The number of patients dying during the period of hospitalization was recorded as well as stump complications, re-operations and placement after discharge from hospital.

Table 1. Major lower limb amputations for gangrene

Above-knee	115	(35%)
Through-knee	71	(22%)
Below-knee	144	(43%)
Total	330	

Table 2. Through-knee amputations

Average age	72 years (38–92)
Males	46/71 = 65%
Concomitant diabetes	12/71 = 17%
Hospitalization time	77 days
Mortality in hospital	10/71 = 14%

## RESULTS

The hospitalization time for through-knee amputees averaged 77 days.

The mortality in hospital was 14 per cent (10/71), as eight patients admitted from home and two nursing home patients died.

Wound healing complications were encountered in 30 per cent (21/71) of cases. Skin necrosis or infection was followed by re-amputation at the above-knee level. This applied to 18 per cent (13/71) of the cases (Table 3). Two patients did not survive this procedure. The remaining stump complications were synovial fistulas, which dried out spontaneously and did not disturb the prosthetic fitting.

Among the eleven surviving patients admitted from a nursing home no re-amputations were performed, but only two patients managed prosthetic gait, the remainder being confined to a wheelchair (Table 4).

Among patients admitted from their own home 20 per cent (10/50) were discharged to a nursing home, including two patients re-amputated at the above-knee level. These patients were all confined to a wheelchair.

Thus 31 patients with preserved through-knee amputation level were discharged to their own home, although five patients spent a period of time at a rehabilitation institution prior to this.

Table 3. Postoperative course for through-knee amputees

Wound healing complications	21/71 = 30%
Re-amputation	13/71 = 18%

Table 4. Prosthetic fitting of through-knee amputees

Discharged to	Prosthetic gait	Wheelchair
Nursing home	2	17
Home or rehab. inst.	30	1
Total	32	18

Only one of these patients was wheelchair bound (Table 4), prosthetic fitting having been accomplished in 97 per cent (30/31). Among the ambulant patients there was one with bilateral through-knee amputations and four with contralateral below-knee amputations. Walking with a prosthesis outdoors was possible in 71 per cent (22/31) of the patients discharged to their own home, whereas 26 per cent (8/31) were only able to walk indoors. The mean age of the ambulant patients was 71 years.

## DISCUSSION

The lack of popularity of the through-knee amputation level is probably due to a less successful cosmesis following prosthetic fitting. This is caused by the fact that the knee joint of the conventional prosthesis requires space and thus protrudes in the sitting position. This is especially obvious in women, when a uniaxial knee joint is applied. The cosmetic problem can be solved to a certain extent by applying a polycentric knee with a four-bar linkage mechanism, although this knee joint is considered to be less stable by the patients.

The advantages of the through-knee amputation level are, however, a stump with good proprioception and total end bearing. The bulbous, triangular shape secures the rotational stability of the fitted prosthesis. Prosthetic gait is facilitated by the long and strong lever arm for the well balanced thigh muscles and the preserved hip function.

As demonstrated in the present series a high rate of successful prosthetic fittings of more than 90 per cent can thus be expected among patients returning to their home. This is achieved in spite of every fourth patient being above 80 years of age. It is, however, a basic principle in our department that any patient able to walk prior to the amputation should be fitted with a prosthesis. These efforts are also reflected in the long hospitalization time. It must also be underlined that mobilization of these elderly patients is sometimes facilitated by applying a knee lock. A high success rate of prosthetic fitting has been reported previously (Batch et al. 1954, Chilvers et

al. 1971, Early 1968, Howard et al. 1969, Newcombe & Marcuson 1972).

Considering the advanced age of the patients it is understandable that every fifth patient admitted from home is discharged to a nursing home. This also applies to below-knee amputees, and more particularly to above-knee amputees (Jensen et al. 1981).

Stump complications are rather frequent and result in re-amputation above the knee in every fifth case, which is double as many as reported by Baumgartner (1979), but consistent with the results of others (Green et al. 1972, Hopkins & Harris 1965, Howard et al. 1969, Newcombe & Marcuson 1972). A synovial fistula without obvious infection or a large amount of skin necrosis should, however, be treated conservatively and not impair the accomplishment of the prosthetic fitting.

The rate of re-amputations is comparable with the results of below-knee amputations at our clinic (Jensen et al. 1981). It should, however, be emphasized that re-amputation following below-knee stump complications is rarely practicable at the through-knee level, but results in an above-knee amputation (Jensen et al. 1981). There is no doubt that many stump problems can be avoided by paying special attention to skin tension, and for the through-knee stump this applies especially to the skin over the medial femoral condyle. It should also be mentioned that a too distal positioning of the knee cap between the condyles should be avoided.

In our opinion a through-knee amputation is a good reconstructive operation. In all previously ambulant patients this level should be considered before an above-knee amputation is undertaken. In cases with borderline skin perfusion pressure on the shank the through-knee level should also be considered as an alternative to the below-knee level. It is also our belief that the through-knee level should be preferred to the below-knee level in very old and feeble patients with weak muscles and poor balance. This is because of the solid end bearing stump, the ease of putting on the prosthesis and the stability in walking with a locked knee joint.

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