

Hospital Cochin, Paris 14, France.

RECONSTRUCTION OF THE KNEE BY PEDICLED PATELLAR TRANSPLANT

R. MERLE D'AUBIGNE

Accepted 10.iv.73

When a femoral condyle or a tibial tuberosity is destroyed by trauma or infection or has to be removed for tumour, knee arthrodesis, with or without graft, is the most currently accepted procedure.

But ankylosis of the knee is a severe infirmity, and, when a sound femoro-tibial joint is preserved on the medial or lateral side, preservation of the knee function by reconstruction of the condyle appears as highly desirable. This should be possible, theoretically, in three ways: inert prosthesis, homogenous bone graft, or, as we propose, pedicled autograft.

Inert prosthetic replacement of one condyle should be possible, but would need a big material, especially after large resection of a tumour: superficially placed as it would be, the risk of the suture breaking up, with primary or secondary infection, is to be feared.

Replacement of the condyle by a massive homogenous free graft, with its cartilage, is possible, provided a suitable material is obtainable: a very hazardous condition, except, probably, in Moscow. But it has been shown clinically (Lexer 1909, Burkle de la Camp 1959) and experimentally (Herndon & Chase 1952) that such a graft would undergo massive necrosis: it would unite with the host bone and probably provide a good function for some time: but disorganisation, collapse of the bone and absorption of the cartilage would certainly occur during the slow process of revascularisation and reconstruction by creeping substitution.

By deep refrigeration as a means to reduce antigenic power of the graft, Volkov (1970) has published better results, but follow-up of his cases is still a little short.

At the present time a vascularised transplant appears more likely to stand the stress and strain of an articular surface.

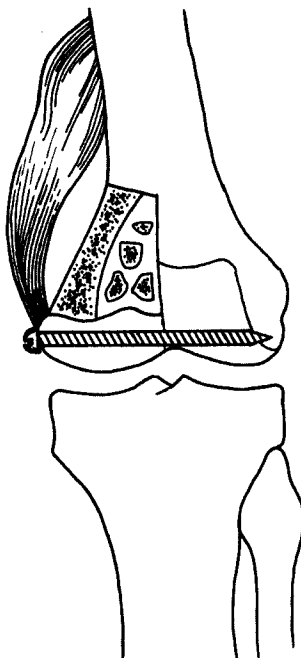


Figure 1. Diagram of the operation. Reconstruction by pedicled patella of a femoral condyle after resection.

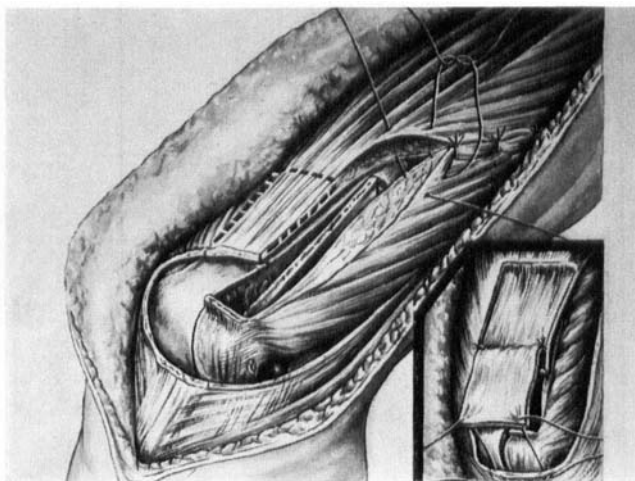


Figure 2. The patella is fixed to the remaining condyle by a screw: its anterior surface covered by the fascia replaces the articular surface. A cortical graft (auto or homogenous) is placed between the femur and the patella. Reconstitution of the quadriceps tendon using the tendon of rectus femoris.



Figure 3. Case 2. Male 19 years. A: Destruction of femoral condyle by war wound. B-C: 19 years after resection and reconstruction by pedicled patella and cancellous grafts.

MATERIAL AND METHODS

In 1945, we used patella transplanted with a vascular pedicle to reconstruct a destroyed femoral condyle in two cases of war wounds: both enjoy a mobile and stable knee 25 years later (Figure 3).

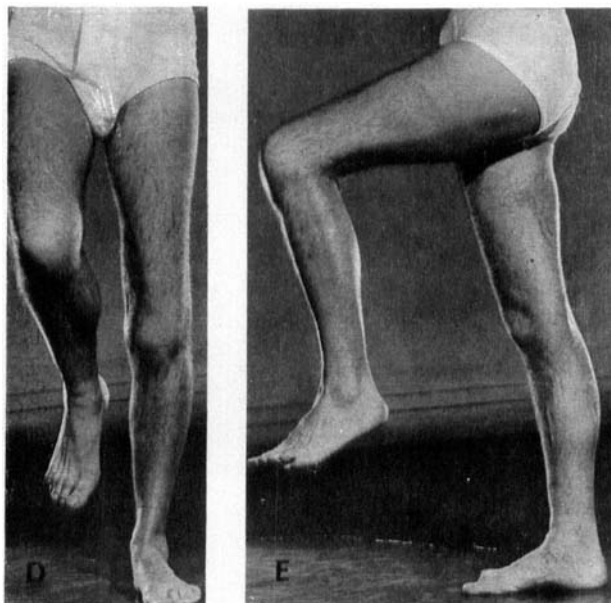


Figure 3. D-E. Left knee stable and mobile.

Nine other cases have been submitted to the same operation: one was traumatic, one was a child with condylar destruction due to osteomyelitic infection in the first days of life. The eight other cases were giant cell tumours of a femoral condyle in six cases, of a tibial condyle in two cases.

Resection reconstruction of a femoral condyle

By a long antero-medial or antero-lateral incision the patella and the quadriceps tendon are exposed.

A muscular pedicle is separated, about 3 cm wide, at the inferior border of the vastus medialis or lateralis, preserving as many vessels as possible, from the supracondylar portion of the femur to the lateral border of the patella (Figures 1 and 2).

The patella is then separated from the quadriceps tendon along its superior, lateral, or medial and inferior borders, keeping 3 to 4 mm clear from the bone to spare the circular artery supplying blood to the patella through an anterior subaponeurotic network.

The femoral condyle is then exposed and can be removed "en bloc" with the tumour, by cutting the femur with an oscillating saw, in a median or paramedian sagittal plane, and transversally at the upper limit of the lesion.

The patella is then prepared: its anterior superficial aspect will be used as articular surface: its curvature is very similar to the condyle's and the preserved tendinous fibres will play the role of the cartilage. Its medial (or lateral) aspect as well as its deep articular surface are freshened.

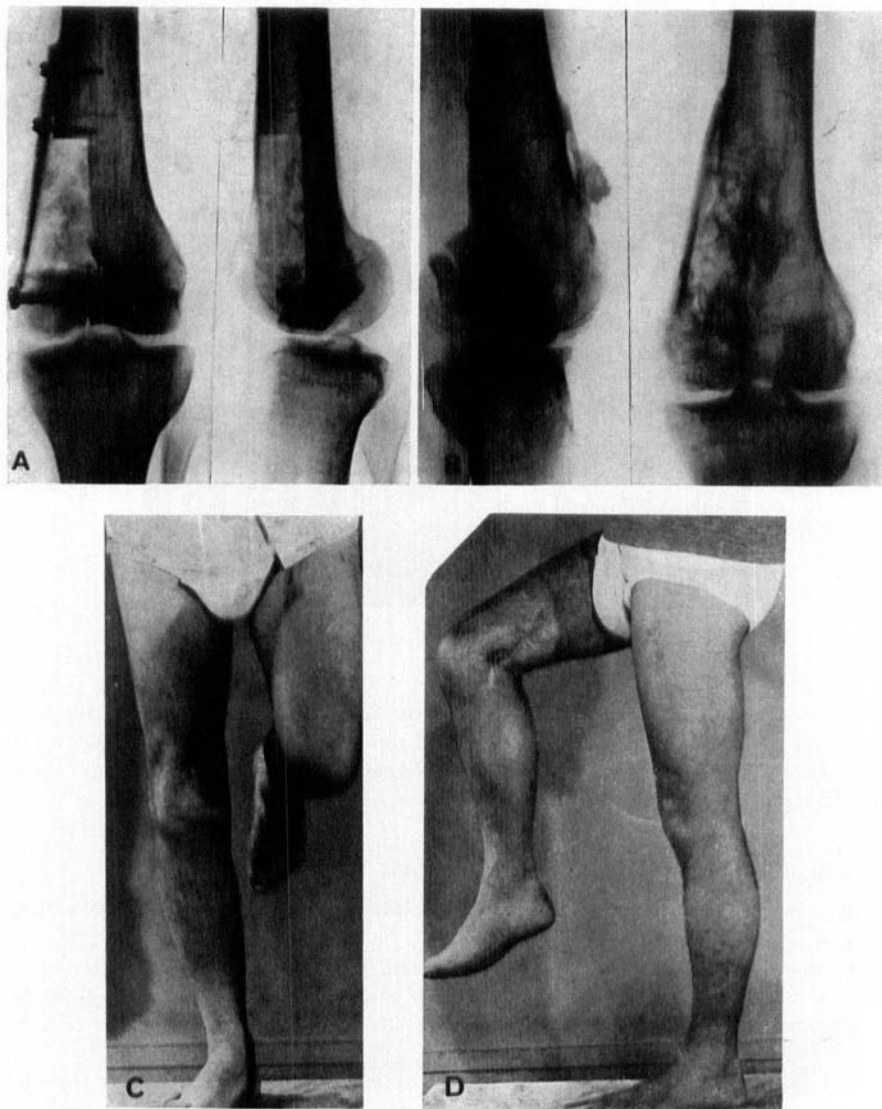


Figure 4. Case 3. Male 31 years. Giant cell tumour of medial femoral condyle. A: X-ray after reconstruction by pedicled patella, tibial graft and cancellous grafts. B: X-ray 7 years post-op. C-D: Mobile and stable right knee.

The patella must be brought in continuity with the other condyle at the same level as was the removed condyle, and firmly fixed there by one or two long screws.

The gap between the patella and the femoral shaft, if small, can be filled by bone chips taken from the iliac crest. If it is large, it is preferable to use either

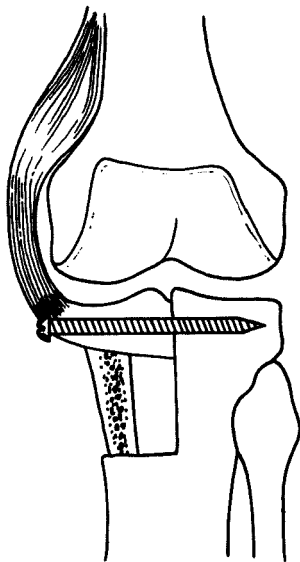


Figure 5: Diagram of reconstruction by patella after resection of a tibial condyle.

a massive homograft or combined cancellous graft and cortical tibial graft (Figure 2). The grafts must be firmly fixed by screws.

Finally, the gap in the quadriceps is closed using the large aponeurotic tendon of the rectus femoris, easy to isolate in the muscle: the aponeurotic flap, turned down, is fixed to the patellar ligament, to the remaining expansion of the vastus, and to the femoral fascia (Figure 2).

After careful hemostasis and closure of the superficial layers, a compressive bandage is applied. A posterior plaster splint prevents excessive flexion, but is removed every day from the first post-operative day for active flexion and supported extension exercises.

At the end of the first week, active oscillating movements in the standing position are prescribed. Weight-bearing is delayed until the end of the third month.

Resection reconstruction of a tibial condyle

The operative technique is similar as far as the approach and isolation of the patella are concerned. But, after resection of the tibial condyle, the patella is placed horizontally, with its articular surface upwards, in normal relationship with the femoral condyle.

RESULTS

In all eleven cases the postoperative course was simple. No infection occurred. Mobility was preserved in all cases to 90° or more. Stability in extension was good: some lateral movement appeared in flexion.

Table 1. Reconstruction of the knee after

Cases. Age	Lesion	Condyle	Technique
1. M.33	War wound	Fem.	Pedic. patella + cancellous graft
2. M.19	War wound	Fem.	Pedic. patella + cancellous graft
3. M.31	Giant cell tumour	Fem.	Pedic. patella + tibial graft + cancellous graft
4. M.56	Open comm. fracture	Fem.	Pedic. patella + cancellous graft
5. M.57	Giant cell tumour	Fem.	Pedic. patella + homograft + plate.
6. M.26	Giant cell tumour	Fem.	Pedic. patella + homograft
7. M.25	Giant cell tumour	Fem.	Pedic. patella + homograft + tibial graft
8. F.34	Giant cell tumour	Fem.	Pedic. patella + homograft
9. F.6	Osteomyelitis	Fem.	Pedic. patella
10. F.32	Giant cell tumour	Tibial	Pedic. patella + homograft

Function was excellent. The three first cases reviewed after 23, 22 and 11 years can walk as long as they like, run and ski.

In two cases of reconstruction of the medial femoral condyle, some varus deformity appeared 6 years after the operation in one case and 15 years postoperatively in the other. Tibial corrective osteotomy was performed in both cases with good result.

The results we have reported (Table 1) show that the patella plays the role it is supposed to: the living articular surface stands the test of time (more than twenty years in two cases). The quadriceps strength is only slightly diminished.

This operation appears as useful in some traumatic destructions of

resection of femoral or tibial condyle.

Follow-up (years)	Mobility	Result	
		Stability	Observation
21	Very good	0-100°	Can run - ski
20	Very good	3-80°	Varus deformity - tibia osteotomy; can walk any distance, no pain
11	Good	5-90°	Varus deformity, corrected by tibial osteotomy, can ski, any distances
2	Very good	5-90°	Walks with one cane
4	Good	5-70°	Walks 1 km, no limp
3½	Good	0-120° After reoperation	Walks any distance. No limp - works standing
2½	Good	0-90°	No pain, no limp, back to work
3	Good	0-85°	Slight limp. Occasional pain.
1½	Some laxity	0-60°	Walks with a brace
1½	Good	0-125°	No pain - no limp

a condyle, in an agenesis of a femoral condyle after newborn osteomyelitis, but mostly in giant cell tumours: these tumours can be removed "en bloc" provided they do not transgress the middle sagittal plane of the bone, with preservation of the joint function. No recurrence of the tumour occurred in the severe cases where this technique of removal was used.

SUMMARY

A technique is presented for reconstruction of a femoral or a tibial condyle using the patella maintained alive by a musculo-vascular pedicle. This operation, used in eleven cases after traumatic destruction

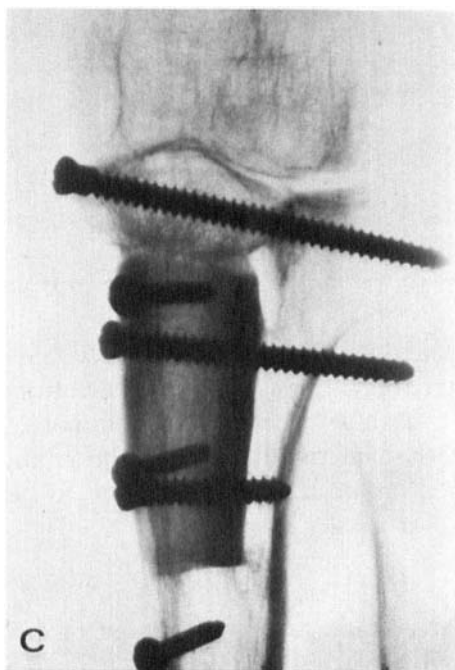
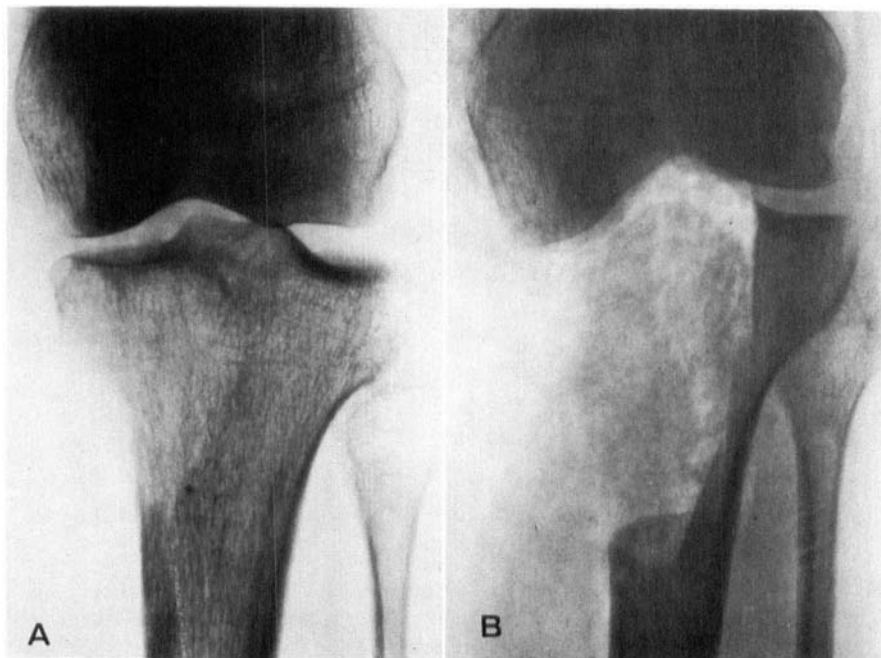


Figure 6. Case 10. Female 32 years.
A: Aggressive giant cell tumour of the medial tibial condyle. **B:** Resection. **C:** Reconstruction by pedicled patella and massive homograft.

of a condyle or surgical removal for tumour, has given satisfactory results with preservation of knee stability and mobility. Follow-up up to 23 years.

REFERENCES

- Burkle de la Camp (1959) Evolution of massive articular homografts. *Z. Chir.* **217**, 109.
- Herndon, C. H. & Chase, S. W. (1952) Experimental studies in the transplantation of whole joints. *J. Bone Jt Surg.* **34-A**, 564.
- Lexer, E. (1909) Veber Gelenktransplantation. *Arch. klin. Chir.* **90**, 263.
- Lexer, E. (1925) Joint transplantation and arthroplasty. *Surg. Gynec. Obstet.* **40**, 782.
- Merle d'Aubigne, R. & Alexandre, G. (1966) Reconstruction femorale par greffe rotulienne pediculee. *Rev. Chir. orthop.* **52**, 611-633.
- Merle d'Aubigne, R., Meary, R. & Thomine, J. M. (1966) La resection dans le traitement des tumeurs des os. *Rev. Chir. orthop.* **52**, 305-324.
- Volkov, M. (1970) Allotransplantation of joints. *J. Bone Jt Surg.* **52-B**, 49-53.

Correspondence to:

R. Merle d'Aubigne
Hospital Cochin
Paris 14, France