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Indications for cryopreserved allografts in tumoral pathology

D. Poitout, P. Tropiano, M. Bernat and J.F. Moulene

Service de Chirurgie Orthopédique et de Traumatologie, CHU Nord, Chemin des Bourrely, F-13915 Marseille Cedex 20, France

Summary: The use of preserved bone is not a recent technique and the first reported cases of fresh allografts date fom the beginning of the 19th century; many authors have practised such procedures with results judged good in over 50% of the cases. However, bony reconstruction after surgical excision for tumors still raises certain problems, which are not entirely resolved. This is a study in relation to massive grafts used to replace diaphyseal fragments or articular surfaces. The use of prostheses ensheathed by bank bone is an intermediate solution combining firmness with articular stability and muscular reattachment to the periprosthetic bone. This technique should be used whenever the loss of bone substance renders revascularisation of the graft uncertain.

Key words: Allograft — Bone tumors

Material and methods [16]

1. Without restricting oneself to the indications for the packing of bony cavities with cancellous grafts or acetabular reconstruction with cortico-cancellous grafts, it may be useful to have in the bone bank large fragments, (e.g. hemi-pelvis) to permit replacement of the hemi-pelvis [16], when acetabular destruction is excessive or when there is a bone tumor, by an allograft in which is fixed a total hip prosthesis [4, 5, 12] .

2. Massive diaphyseal or epiphysometaphysal grafts will allow reconstruction of the locomotor system after excision of a tumor or after posttraumatic loss of substance. Twelve massive grafts were inserted during the period from 1988 to 1995 [2, 3].

If it is required to replace a large diaphyseal fragment, we think it is preferable to use centromedullary nailing, leaving the muscle masses in good contact with the graft, so allowing development of the maximal peripheral vascularisation. Bolting of this nail may be necessary if the upper and lower parts of the receptor bone segment are inadequate; this is clearly possible only if sufficient receptor bone remains [11].

3. Osteocartilaginous grafts of varying size may be used to replace articular surfaces destroyed by a tumoral or traumatic process. Fourty-two osteocartilaginous allografts have been inserted with a follow-up of 1-7 years (1988-1995), including 5 total articular grafts of the knee. As an articular graft requires capsuloligamentous coaptation, one may use the capsular cuff removed with the graft or attach the capsule and ligaments of the receptor directly to the donor bone by transosseous sutures. This latter method gives better stability to the limb [10].

In the event of development of articular necrosis, this is painless because absence of innervation of the bone fragment, and would require only partial replacement of the jolnt surface by means of a small-sized prosthesis some years later [6, 13].

The same problem arises with the possible development of incapacitating ligamentous laxity, which might even-

Table 1. Bony and osteochondral allografts, 1979-1995 [17, 18, 26-28]. Total = 1273

Cancellous, cortical and osteocartilaginous allografts	652 cases
Massive diaphyseal and cortico-cancellous grafts	223 cases
Reconstruction of hip:	
Cancellous, acetabulum and hemi-pelvis	312 cases
Acetabulum and hemi-pelvis of which hemi-pelvic grafts	37 cases 18 cases
Prostheses sheathed by bank bone	22 cases
Massive osteocartilaginous grafts	64 cases

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Correspondence to: D. Poitout

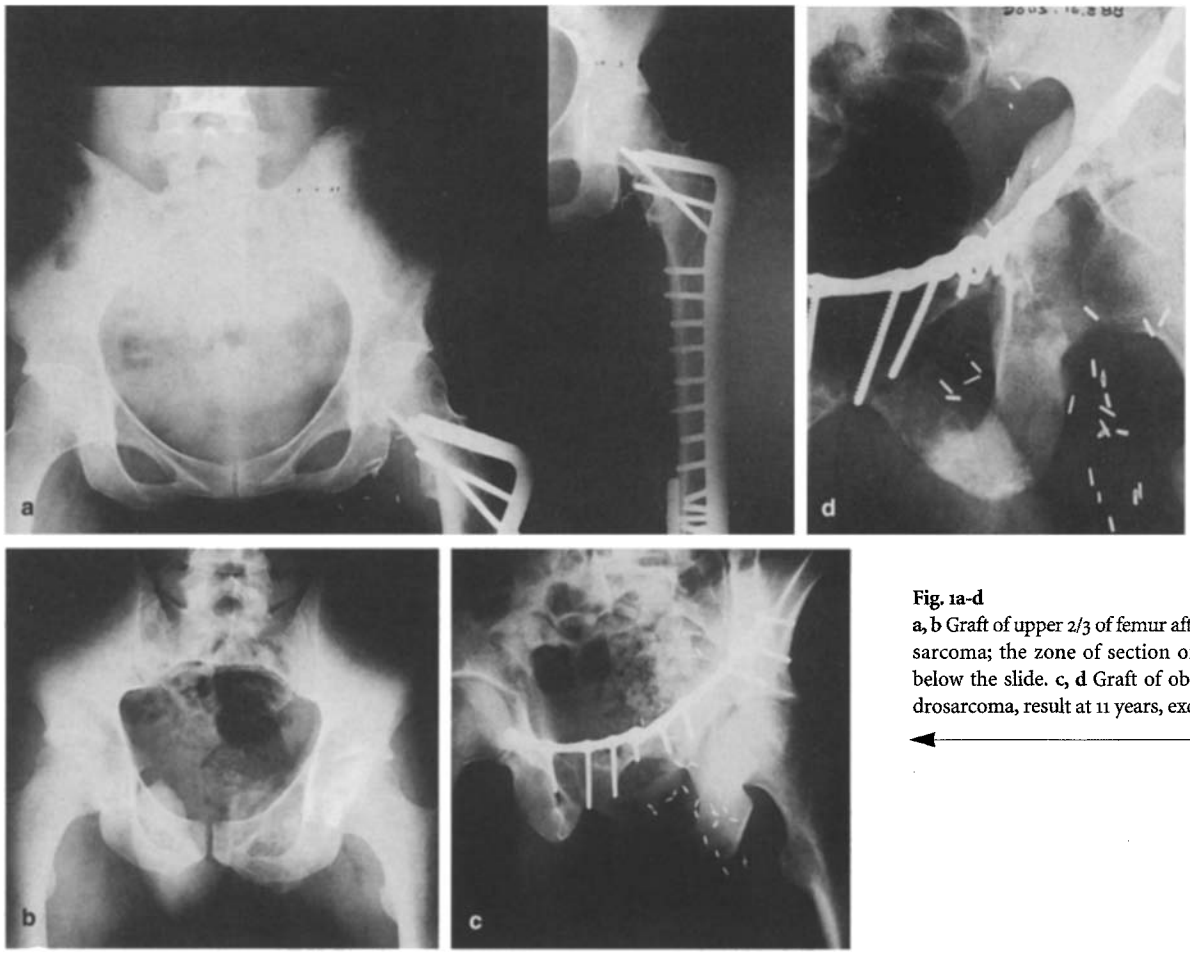

Fig. 1a-d
a, b Graft of upper 2/3 of femur after excision of a Ewing's sarcoma; the zone of section of the neck is at 3 mm below the slide. **c, d** Graft of obturator ring for chondrosarcoma, result at 11 years, excellent incorporation

tually justify stabilisation by a prosthetic ligament or a preserved human ligamentous graft. Our present policy is the routine insertion of ligamentous reinforcement as a primary measure to strenghten the grafted ligaments, so as to avoid excessive tension on these, giving rise to rupture or stretching.

4. The risks of secondary damage to the joint surface related to problems of ligamentous stability led us to propose the use of prostheses sheathed in bank bone, which have the advantage of eliminating problems of cartilage viability with its risks of necrosis, and of secondary ligamentous laxity and articular instability. The bony allograft ensheathing the metal core of a prosthesis allows the adjacent muscles to reattach rapidly to the grafted zone, which gives much less uncertain functional results. Twenty two reconstructions using sheathed prostheses were used during the period from 1988 to 1995 for the treatment of sarcomas of the knee [20].

Results [7, 8, 9]

The complications specific to the use of massive allografts set the current bounds to this surgery, which must only be performed when tumoral excision has the same carcinologic value as an amputation, and when the strictest precautions are observed during removal of the grafts to prevent them from transmitting iatrogenic disease [21, 22, 23].

Early or secondary postoperative deaths were observed only in cases of major surgery of the pelvis for advanced tumoral lesions.

Infective risks were comparable in the different groups and were essentially lined to the quality of the skin healing under chemotherapy (around 6%). Fractures of the graft occurred when the osteosynthesis was inadequate or when rehabilitation was over-aggressive (zones unprotected by osteosythesis material) [24, 25].

Nonunion of the bone ends was rare if the junction of allograft and receptor bone was surrounded with autologous cancellous bone at the first procedure. Joint instabiity and arthrotic lesions were related to the stability of the ligamentous reconstruction. The cartilage cells were represented, and the cartilage thickness - even though diminished - ensured correct joint function.

No arthropathy of Charcot type was demonstrable, the periarticular innervation doubtless maintaining trophic joint function [1].

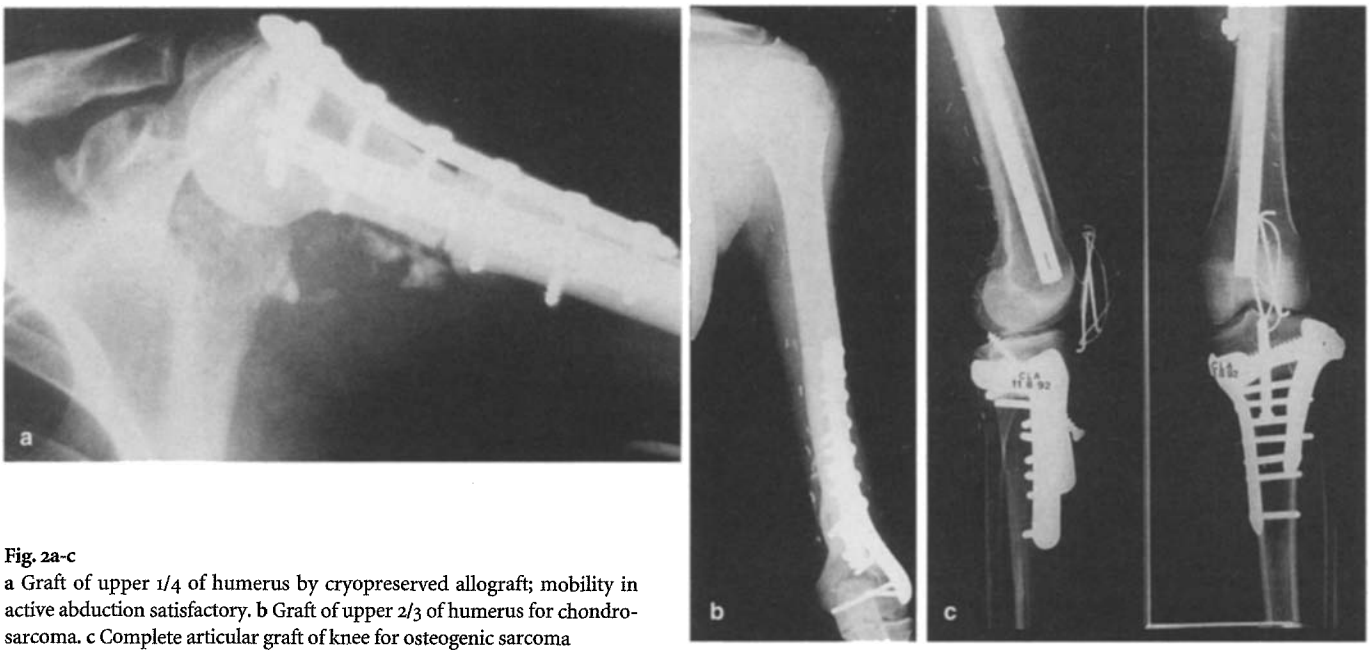

Fig. 2a-c
a Graft of upper 1/4 of humerus by cryopreserved allograft; mobility in active abduction satisfactory. b Graft of upper 2/3 of humerus for chondrosarcoma. c Complete articular graft of knee for osteogenic sarcoma

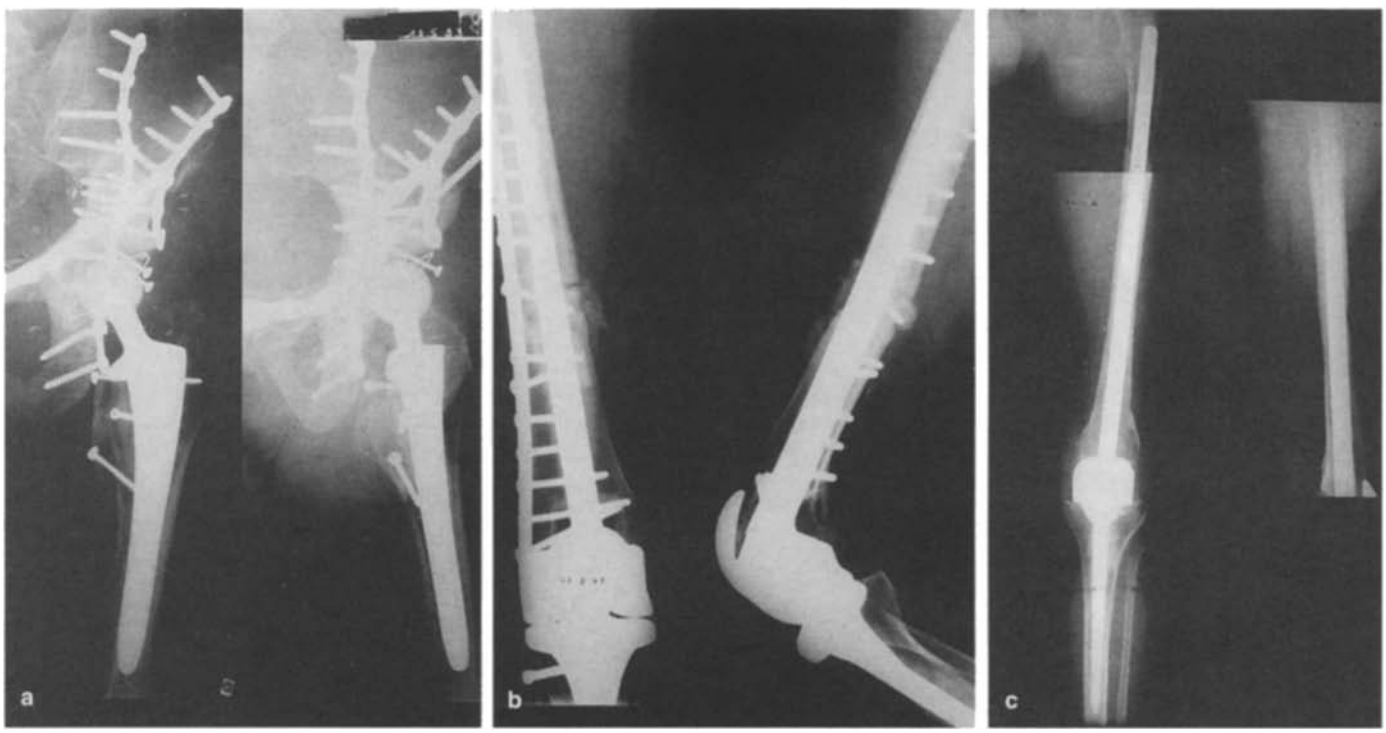

Fig. 3a-c
a Graft of acetabulum ensheathing cup of hip prosthesis. b, c Reconstruction prosthesis ensheathed by bank bone; result at 5 years, bony integration

Discussion [15]

Revascularisation of the graft, its incorporation in the skeleton, the fate of grafted cartilage and that of ligamentous structures reattached to the graft or used as allografts, all still pose problems as yet not entirely resolved. These massive grafts must certainly be studied over a longer period, but the first results at 15 years are valuable [14].

The intermediate solution represented by the insertion of a prosthesis cuffed by bank bone seems indicated in cases where tumoral resection is wide and removes bone, cartilage, ligaments and muscles [19]. These cuffed pros-

theses allow reattachment of the muscles to the graft and so limit the risks of rupture of the stem and its loosening. The use of a tibial graft including the patellar tendon facilitates reconstruction of the extensor apparatus of the knee. However, if rehabilitation is not undertaken very soon and continued regularly over several months, the graft promote muscle adhesions, a source of sometimes major restriction of joint movement [13].

Conclusion

The use of massive cryo-preserved allografts is a proven development in our therapeutic arsenal. However, it is unreasonable to expect from such grafts, results that would not be expected in the treatment of a simple fracture. They are often used in extreme conditons and often provide unexpectedly good results.

The last problem for solution is that of the stocking of banks of human tissues and grafts, where much opposition has still to be overcome. Even if the legislative obstacles are dealt with, the information of the doctors and public is still inadequate and calls for an effort from all of us so that the use of human grafts may occupy tomorrow an increasingly important place in our treatment [28].

References

1. Friedlander G (1983) Immune response to osteochondral allografts. Clinical Orthopaedics 174: 58-67
2. Gross A, Mc Kee N, Pritsker K, Langer F (1983) Reconstruction of skeletal deficits at the knee. Clinical Orthopaedics 174: 96-106
3. Mankin HJ, Doppelt SH, Sullivan TR, Tomford WW (1982) Osteo-articular and intervalary allograft transplantation in the management of malignant tumors of bone. Cancer 50: 613
4. Mankin HJ, Doppelt S, Tomford WW (1983) Clinical experience with allograft implantation. Clinical Orthopaedics 174: 69-86
5. Poitout D (1985) Conservation et utilisation de l'os de banque. Cahier d'enseignement de la SOFCOT N° 23, Expansion Scientifique, Paris, pp 157-177
6. Poitout D (1986) Greffes utilisées pour reconstruire l'appareil locomoteur. Masson, Paris
7. Poitout D, Novakovitch G (1986) Allogreffes et banque d'os. Encyclopédie médico-chirurgicale, Paris. Appareil Locomoteur 14015 A10-5, 1986, p 6
8. Poitout D, Novakovitch G (1987) Utilisation des allogreffes en oncologie et en traumatologie. International Orthopaedics 11: 169-178
9. Poitout D (1987) Allogreffes ostéo-cartilagineuses des membres inférieurs. Communication au Symposium sur la Gonarthrose, Montpellier, 4-6 Juin 1987. In: La Gonarthrose. Masson, Paris
10. Poitout D (1987) Place des allogreffes ostéocartilagineuses en chirurgie orthopédique. Entretiens de Bichat, Paris, 28-29 Septembre 1987. Expansion Scientifique Française
11. Poitout D, Gérard Y (1987) Biologie des allogreffes osseuses. Symposium Banques d'Os (Allogreffes). 62ème Réunion Annuelle de la SOFCOT, Paris, 10-15 Novembre 1987. Revue de Chirurgie Orthopédique N°2: 112 - 114
12. Poitout D, Gérard Y (1987) Indications classiques des allogreffes osseuses. Symposium Banque d'Os (Allogreffes). 62ème Réunion Annuelle de la SOFCOT, Paris, 10-15 Novembre 1987. Revue de Chirurgie Orthopédique N°2: 118 - 120
13. Poitout D, Gérard Y (1987) Allogreffes massives - Problèmes articulaires. Symposium Banque d'Os (Allogreffes). 62ème Réunion Annuelle de la SOFCOT, Paris, 10-15 Novembre 1987. Revue de Chirurgie Orthopédique N°2: 143
14. Poitout D, Gérard Y (1987) Cryoconservation d'allogreffes osseuses et ostéocartilagineuses - Aspects techniques et administratifs. Symposium Banque d'Os (Allogreffes). 62ème Réunion Annuelle de la SOFCOT, Paris, 10-15 Novembre 1987. Revue de Chirurgie Orthopédique N°2: 143 - 145
15. Poitout D (1988) Les indications et résultats des allogreffes ostéocartilagineuses du membre inférieur. Communication au 6ème Cours International de Techniques Chirurgicales et Technologie de Rééducation du Genou, Montpellier, 2 juin 1988. In: Prothèse de hanche et du genou. Collection de Pathologie Locomotrice, N° 15. Masson, Paris
16. Poitout D (1988) Les allogreffes osseuses. In: Avenir de la Santé, tome 1. Avenir 15 ans
17. Poitout D (1989) L'utilisation des allogreffes ostéochondrales en pathologie traumatique. Communication au 7ème Cours International de Pathologie, Chirurgie et Technique de rééducation du genou, Montpellier, 1-3 juin 1989. In: Le genou traumatique. Masson, Paris, pp 249-252
18. Poitout D (1989) Allogreffes massives ostéo-cartilagineuses ou prothèses manchonnées par de l'os de banque. La Lettre Chirurgicale Octobre 79: 7-13
19. Poitout D (1990) Mega hip prosthesis surrounded by allografts. Custom Made Prosthesis Symposium, Tübingen, Germany, 23-25 Mars 1990. In: Kusswetter W (ed) Noncemented Total Hip Replacement International Symposium. Georg Thieme-Verlag, Heidelberg
20. Gaujoux G, Poitout D (1990) Reconstruction of the acetabulum with cortico-spongiosal allografts. Custom Made Prosthesis Symposium, Tübingen, Germany, 23-25 Mars 1990. In: Kusswetter W (ed) Noncemented Total Hip Replacement International Symposium. Georg Thieme-Verlag, Heidelberg
21. Poitout D, Gaujoux G, Lempidakis M (1990) Reconstructions iliaques totales ou partielles à l'aide d'allogreffes de Banque. 18th World Congress SICOT 90, Montréal, 9-14 Septembre 1990. International Orthopaedics 14: 111-119
22. Poitout D, O'Zoux (1991) Utilisation des allogreffes en traumatologie. Journées du Genou, Montpellier, 6-8 juin 1991. In: Le Genou - Stratégies-Diagnostiques et Thérapeutiques. Springer-Verlag, Paris Berlin Heidelberg New York, pp 221-228
23. Poitout D, Gaujoux G, O'Zoux P, Filippi C, Lempidakis M (1991) Reconstructive hip prosthesis surrounded by allografts. Hip International 1: 70-78
24. Lempidakis M, Poitout D, Resbeut M (1992) Indications opératoires préventives dans les métastases des os longs. Réunion Annuelle de la Société Belge d'Orthopédie, Liège, 11-13 mai 1992. Orthopedica Belgica
25. Roy-Camille R, Laugier A, Ruyssen S, Chenal C, Bisserie M, Pene F, Saillant G (1981) Evolution des greffes osseuses cortico-spongieuses et radiothérapie. Revue Chirurgicale Orthopédique 67: 599-608
26. Tomford WW, Fredericks GR, Mankin HJ (1982) Cryopreservation of intact articular cartilage. Trans Orthop Res Soc 7: 176
27. Tomford WW, Doppelt S, Mankin HJ (1983) Bone bank procedures. Clinical Orthopaedics 174: 15-21
28. Tomford WW, Mankin HJ (1983) Investigational approaches to articular cartilage preservation. Clinical Orthopaedics 174: 22-27

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Indications des allogreffes cryopréservées en pathologie tumorale

Les allogreffes massives peuvent être utilisées isolément ou en manchonnement de prothèses articulaires. Dans tous les cas leur fixation doit être stable.

Malades et méthodes.

1- Allogreffes diaphyso-métaphysaires. 12 greffes massives diaphyso-métaphysaires ont été mises en place durant la période allant de 1988 à 1995.

2- Allogreffes ostéocartilagineuses massives. Les reconstructions articulaires utilisant des allogreffes ostéocartilagineuses massives sont de plus en plus souvent pratiquées dans le domaine de l'oncologie courante.

Du fait des possibilités de réhabitation à distance et plus immédiatement de la reconstruction d'une surface articulaire anatomique, et compte-tenu de ses résultats à moyen terme, l'allogreffe semble donner des résultats fonctionnels encourageants qu'il faut comparer à ceux des grandes prothèses de reconstruction.

Les indications opératoires sont donc posées beaucoup plus fréquemment chez des sujets jeunes ayant eu une exérèse partielle ou totale d'une articulation pour tumeur.

L'expérience que nous avons de ces allogreffes ostéocartilagineuses massives est de 42 cas avec un recul de 2 à 7 ans (1988-1995) dont 5 greffes articulaires complètes du genou.

3- Prothèses manchonnées. 22 reconstructions utilisant des prothèses manchonnées ont été utilisées durant cette même période (1988 - 1995) pour traiter des sarcomes du genou.

Résultats. Les risques septiques sont comparables dans les différents groupes et essentiellement liés à la qualité de la cicatrisation cutanée sous chimiothérapie. Les fractures du greffon surviennent quand l'ostéosynthèse est insuffisante ou la rééducation trop agressive. La non consolidation des extrêmités osseuses est exceptionnelle si l'on évite la jonction de l'allogreffe et de l'os receveur avec du tissu spongieux autologue. L'instabilité articulaire et les lésions arthrosiques sont fonction de la stabilité de la reconstruction ligamentaire. Aucune arthropathie de type Charcot n'a pour l'instant été mise en évidence, l'innervation péri-articulaire maintient la trophicité de l'articulation.

Discussion. La revascularisation du greffon, son intégration au squelette, le devenir du cartilage greffé ainsi que celui des formations ligamentaires refixées sur le greffon ou utilisées comme allogreffes posent encore des problèmes incomplètement résolus. Ces greffes massives doivent être étudiées sur un laps de temps certainement plus long mais les premiers résultats sont intéressants. La solution intermédiaire que représente la mise en place d'une prothèse manchonnée par de l'os de banque semble être indiquée dans les cas où la résection tumorale est large enlevant os, cartilage, ligaments et muscles. Ces prothèses manchonnées en autorisant la refixation des muscles sur la greffe limitent les risques de rupture de la tige et de son descellement. L'utilisation d'un greffon tibial comportant le tendon rotulien facilite la reconstruction de l'appareil extenseur. Mais, si la rééducation n'est pas entreprise très rapidement, et poursuivie régulièrement pendant plusieurs mois, la greffe favorise les adhérences musculaires sources de limitation, parfois importante, des amplitudes articulaires.

Mots-clés : Allogreffe — Tumeurs osseuses