REVIEW ARTICLE

Free Fibula Flap in Traumatic Femoral Bone Reconstruction: A 10-year Review

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Abstract

Introduction: The loss of femoral bone substance represents a major therapeutic issue. When the loss of bone substance is extensive, or the local condition is unfavourable, there are few satisfactory solutions. In this study, we share our experience of large femoral bone reconstruction by free fibula flap.

Materials and methods: A retrospective monocentric chart review (2007–2017) was performed for 26 patients after receiving a pure bone-free fibula flap operation. The times of consolidation and hypertrophy of the graft were analysed according to the fixation with a 2-year follow-up.

Results: The time to consolidation was 8.7 months (range, 6–15) for double plates, 7.2 months (range, 5–11) for locked plates, 6 months (range, 5–7) for external fixators and plate blades and 8 months (range, 7–9) for intramedullary nails.

Full weight-bearing was resumed at an average of 6.5 months (range, 5–10) postoperatively. It was authorised at 7 months (range, 5–10) for patients fixed by double plate, at 6.3 months (range, 5–9) for those fixed by a locked plate, at 5.5 months (range, 5–6) for those fixed by an external fixator or plate blade and at 7 months for those fixed by an intramedullary nail.

Conclusion: Free fibula flap remains reliable in the face of a great loss of bone material after trauma, with high consolidation rates. The choice of fixation must be reasoned and should offer a compromise between stability, allowing consolidation and hypertrophy of the graft, and rigidity, exposing the risk of massive osteosynthesis dismantling. Other multicentric studies, including more patients, should be carried out to compare the techniques of fixation.

Keywords: Bone reconstruction, Femoral reconstruction, Free fibula flap, Loss of bone substance.

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Introduction

The free fibula flap has revolutionised the management of extensive bone defects in trauma. As early as 1905, Huntington had the idea of removing the autologous fibula to reconstruct the tibia, but consolidation failures and the absence of graft hypertrophy were standard because they were not vascularized. The first reported case of the use of a vascularised fibula flap dates back to 1975 by Taylor,[1] used for the reconstruction of a large contralateral tibial defect. The benefit of vascularised bone transfer is twofold: to provide a large graft (up to 25 cm in length) and vascularised tissue with better defence abilities against infection. In the case of a loss of femoral substance, bone reconstruction must be systematically considered because of the impossibility of keeping the knee joint, making the adaptation of limb prostheses more complex and less functional. In addition, this very often requires the production of a short femoral stump, which is even more difficult to fit. Although this technique is only performed in specialised centres because of the complexity of the operative technique, femoral reconstruction will have a significant impact on the functionality of the limb, therefore greatly impacting the patient's quality of life.

We share our series of femoral reconstructions by bone transfer of free fibula, which is the largest series known about this topic and includes 26 patients that were operated upon between 2007 and 2017 in the Department of Hand Surgery and Reconstructive Surgery of the Members of the Marseille University Hospital.

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The aim of this study was to analyse the results of these reconstructions in terms of graft consolidation and hypertrophy, and according to the type of fixation and flap technique performed.

The main aim of this work is thus to evaluate the effectiveness of femoral reconstructions using vascularised fibula flaps, in order to assess their effectiveness in the face of lengthy patient care (much more so than in the case of amputation). In addition, we are trying to evaluate which means of bone fixation should be preferred in the context of these complex reconstructions. Our main hypothesis regarding this section is that the most rigid hardware (double plate) will provide the best consolidation possibilities for this flap.

Materials and Methods

Inclusion and Exclusion Criteria

In order to collect all of the femoral reconstructions by free fibula, we identified all files associated with the codes corresponding to post-traumatic femoral bone substance loss repair by free fibula between 2007 and 2017 (excluding oncological resections, paediatric subjects, osteomyelitis and aseptic osteonecrosis). We intentionally excluded nontraumatic lesions because we thought soft tissues surrounding the loss of substance are not the same as during traumatic, infection or oncological lesions. In addition, we excluded those that required a muscular free flap or reconstruction other than the fibula bone-free flap. During this period, 26 patients operated on in the Hand Surgery and Reconstructive Surgery Department of members of the Marseille University Hospital met our criteria, corresponding to the largest cohort described in the literature concerning free fibula flaps in femoral bone reconstruction.

For each patient, data on gender and age at the time of reconstructive surgery, side and site of the fracture (mid-diaphyseal or supracondylar), traumatic context (road accident, ballistic trauma, fall, work accident, etc.) and the open or closed nature of the femoral fracture were collected. To qualify the skin opening, the Gustilo–Andersen classification[2] was used.

Finally, later complications, such as the recurrence of infection, the loosening of internal fixation or stress fractures of the graft were investigated, and their management was specified.

Septic Status

Similarly, the septic or aseptic status and the presence of pre-reconstruction antibiotic therapy were systematically analysed. This septic status was identified via samples taken either during interventions prior to reconstruction, or during reconstructive surgery. If the patient presented with an infection preoperatively, an appropriate antibiotic therapy was performed for a minimum of 3 months. The fibula flap was only offered to them when the bacteriological results were negative. If samples collected during the surgical reconstruction revealed an infection, appropriate antibiotic therapy was performed for 3 months. No antibiotic therapy was given to patients with negative cultures.

Surgical Technique

The flap technique described by Judet[3] and Mathoulin[4] is the one used in this study. About 25 cm of fibula can be removed from adults.[5] The fibula can be grafted in a simple way, double barrel, fitted into an allograft, or associated with a conventional bone graft. In the context of femoral reconstructions, performing a split or double barrel sample can be particularly useful.[6–9] The choice of anastomosis site was made intraoperatively. Deep femoral artery end-to-side anastomosis or end-to-end anastomosis of one of its collateral arteries was used for inflow. End-to-end venous suture was performed with a surrounding vein. The choice of fixation depended on the surgeon and his experience, the patient's wishes and the location of the loss of substance.

The type of fixation was also analysed and could be achieved by an external fixator, blade plate, locked plate, double plate or intramedullary nail. Postoperative data were collected through file analysis and systematic patient reviews, with a minimum follow-up of 2 years.

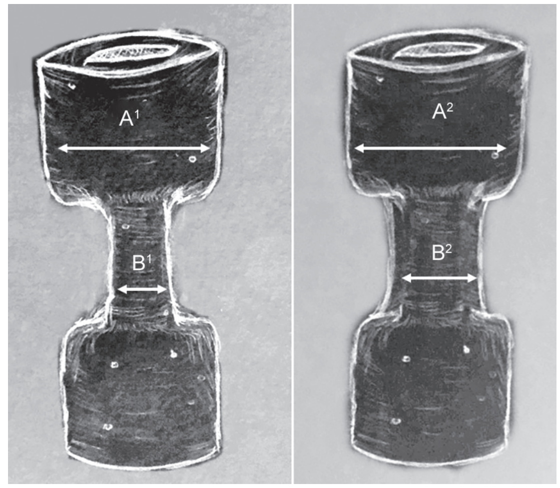


Fig. 1: de Boer and Wood formula, taken over by El-Gammal: Percentage of hypertrophy = (B2/A2–B1/A1)/(B1/A1) B2 corresponds to the diameter of the fibula at a time *t* of reconstruction by a free fibula (in millimetres). A2 corresponds to the diameter of the recipient femur at a time *t* of reconstruction by a free fibula (in millimeters). B1 corresponds to the diameter of the fibula transferred immediately postoperatively (in millimetres). A1 corresponds to the diameter of the recipient femur immediately postoperatively (in millimetres)

Measurement of Graft Hypertrophy

X-rays were taken systematically during the follow-up period, and hypertrophy of the graft was measured according to the formula of De Boer and Wood (taken up by El-Gammal) at 1 and 2 years (Fig. 1).

Results

Preoperative and Intraoperative Data

Between 2007 and 2017, 26 patients benefited from femoral reconstruction by vascularised bone transfer of free fibula in our department. The different characteristics of the cohort are detailed in Table 1. The mean age was 36.15 years (median: 34.5/interval confidence: 30.28–42.03). The mean time before surgery was 27.38 months (median: 16.5/interval confidence: 14.26–40.51) with a mean length of substance loss of 8.4 cm (median: 7.5/interval confidence: 7.25–9.63). Two patients required revision surgery. No patient had a secondary amputation in our cohort.

Surgical Management

Fibula Flap

All patients underwent femoral reconstruction using a pure bone-free flap. In our practice, we perform the reconstruction after a minimum of 2 months after the first Masquelet procedure to allow the appearance of a synovial membrane. However, this is not true for two patients where the reconstruction took place in less than 1 month after the trauma. Regarding the graft used, this consisted of a single fibula for 14 patients, a double-barrel fibula for 6 patients, a single fibula fitted into an allograft for 4 patients (Capanna technique)[10] and, in one case, a cancellous bone graft taken by reamer–irrigation–aspiration (RIA) was added to a simple fibula. Due to a great loss of substance, the patient required reconstruction by bone transfer of two vascularised fibulas.

Six cases of reconstruction by double-barrel fibulas concerned the loss of substance from the supracondylar site. The other

Table 1: Cohort characteristics

Patient	*Sex*	*Age (in years)*	*Side*	*Mechanism*	*Fracture site*	*Opening fracture*	*Delay before fibula flap (in months)*	*Bone infection*
Patient 1	F	36	Right	Road accident	MD	None	41	Yes
Patient 2	M	58	Left	Road accident	SC	None	67	Yes
Patient 3	M	36	Right	Road accident	SC	None	17	No
Patient 4	M	35	Right	Road accident	SC	2	4	Yes
Patient 5	M	18	Left	Road accident	MD	2	5	Yes
Patient 6	F	23	Left	Road accident	MD	None	16	Yes
Patient 7	M	17	Left	Road accident	MD	3a	10	Yes
Patient 8	M	49	Left	Road accident	SC	2	11	No
Patient 9	M	30	Right	Fall	SC	2	4	Yes
Patient 10	M	42	Left	Ballistic	SC	3a	52	Yes
Patient 11	M	20	Right	Road accident	SC	None	11	Yes
Patient 12	M	57	Right	Road accident	MD	None	135	No
Patient 13	M	23	Right	Ballistic	MD	2	1	Yes
Patient 14	F	23	Right	Road accident	SC	1	22	Yes
Patient 15	F	54	Right	Road accident	MD	None	30	Yes
Patient 16	F	52	Left	Road accident	MD	None	53	No
Patient 17	M	64	Right	Road accident	SC	None	1	Yes
Patient 18	M	29	Right	Crushing	SC	3a	91	Yes
Patient 19	F	34	Left	Fall	MD	3a	7	Yes
Patient 20	M	33	Right	Road accident	MD	2	63	Yes
Patient 21	M	43	Left	Road accident	SC	2	17	Yes
Patient 22	F	48	Right	Road accident	SC	2	19	Yes
Patient 23	M	25	Left	Road accident	MD	2	26	Yes
Patient 24	M	54	Right	Road accident	SC	2	3	Yes
Patient 25	M	18	Left	Ballistic	MD	2	2	Yes
Patient 26	M	19	Left	Road accident	MC	3a	4	Yes

seven cases of supracondylar loss of substance underwent simple fibula reconstruction. When the loss of substance was in the mid-diaphyseal, reconstruction was carried out in seven cases by a simple fibula, in four cases by a fibula fitted into an allograft, in one case by two vascularised fibulas, and in one case by a fibula associated with a cancellous bone graft by RIA. Internal fixation was performed by double plate for 11 patients, by locked plate for 9, by external fixator for 2, by blade plate for 2 and by intramedullary nail for 2 (Table 2).

Bacterial Prophylaxis

All patients received postoperative antibiotic therapy, even when no previous samples showed any germ. The mean duration of postoperative antibiotic therapy was 3.1 months (10 days–6 months). Only three patients had only a 10-day probabilistic antibiotic therapy, during which time all of the intraoperative samples returned sterile.

Fibula Flap Consolidation

The time to consolidation was 8.7 months (range, 6–15) for double plates, 7.2 months (range, 5–11) for locked plates, 6 months (range, 5–7) for external fixators and plate blades and 8 months (range, 7–9) for intramedullary nails (Table 3).

Full weight-bearing was resumed at an average of 6.5 months (range, 5–10) postoperatively. It was authorised at 7 months (range, 5–10) for patients fixed by double plate, at 6.3 months (range, 5–9) for those fixed by locked plates, at 5.5 months (range, 5–6) for those fixed by external fixator or plate blade and at 7 months for those fixed by intramedullary nail. Seven patients (27%) presented with a stress fracture on the fibula graft, and all were associated with a displacement of the bone fixation material; none of these patients had a double-plate fixation. There were four cases of fixation by a locked plate, two cases by a blade plate and one case by an external fixator. For the 24 patients where union could be obtained, we followed the evolution of the graft at 1 and 2 years on standard radiographs of the AP femur. The mean hypertrophy was 8% (range, 0–25) at 1 year and 28% (range, 11–51) at 2 years.

Graft Hypertrophy

By separately analyzing the rates of hypertrophy according to the mode of fixation, we found an average hypertrophy of 1% (range, 0–9) at 1 year and 16% (range, 11–20) at 2 years for double plates, 12% (range, 0–25) at 1 year and 34% (range, 28–49) at 2 years for locked plates, 19% (17–21) at 1 year and 48% (45–51) at 2 years for external fixators, 16% (range, 13–19) at 1 year and 39% (range, 35–43) at 2 years for plate blades and 8% (range, 5–11) at 1 year and 24% (range, 20–28) at 2 years for intramedullary nails (Fig. 2).

Discussion

Our results over 10 years report good results, comparable to literature reviews and meta-analyses, with a revision surgery rate of 7.6%, which is lower than what is found in the literature.[11,12]

Table 2: Data and operative management

Patient	*Length of substance loss (in centimetres)*	*Bone fixation*	*Mounting type*	*Graft side*
Patient 1	10	Double plate	Allograft fitted	Ipsilateral
Patient 2	7.5	Double plate	Simple	Contralateral
Patient 3	6	Double plate	Double	Contralateral
Patient 4	5	Double plate	Simple	Contralateral
Patient 5	7.5	External locked plate	Simple	Ipsilateral
Patient 6	7	Double plate	Allograft fitted	Contralateral
Patient 7	11	External fixation	Simple	Contralateral
Patient 8	7	External locked plate	Simple	Contralateral
Patient 9	8	External locked plate	Simple	Contralateral
Patient 10	6.5	External locked plate	Double	Contralateral
Patient 11	7	External locked plate	Double	Ipsilateral
Patient 12	11	External fixation	Simple + RIA	Contralateral
Patient 13	6.5	Double plaque	Simple	Contralateral
Patient 14	7.5	Blade plate	Double	Contralateral
Patient 15	7.5	External locked plate	Simple	Contralateral
Patient 16	5.5	Blade plate	Simple	Contralateral
Patient 17	6.5	External locked plate	Simple	Ipsilateral
Patient 18	7.5	Intramedullary nailing	Simple	Contralateral
Patient 19	15	External locked plate	Allograft fitted	Contralateral
Patient 20	7	Double plate	Simple	Ipsilateral
Patient 21	8	Double plate	Simple	Contralateral
Patient 22	6.5	Double plate	Double	Contralateral
Patient 23	14	Double plate	2 fibulas flap	Bilateral
Patient 24	8.5	Double plate	Double	Contralateral
Patient 25	9	External fixation	Simple	Contralateral
Patient 26	17	Intramedullary nailing	Allograft fitted	Contralateral

At the femoral level, reconstruction must be a priority given the unsatisfactory results of amputations at this level,[13,14] especially when the proximal fragment is close to the coxo-femoral joint. Several considerations must be taken into account before performing a femoral reconstruction.

Bone Graft

The losses of femoral bone substance represent a major therapeutic issue. Reconstruction, when possible, should be systematically sought; as such, free transfer of fibula represents the last resort before amputation.

If pure cancellous grafts were reserved for the limited loss of substances, the appearance of the RIA technique[15] of removing cancellous tissues from long bones (tibia, humerus and femur) combined with a first step of Masquelet, allowed the indications to expand. This technique allows a filling of loss of bone substance up to 25 cm, with a rate of consolidation varying from 70 to 90% depending on the studies;[16] however, this non-vascularised autograft technique does not confer any stabilizing function. In great loss of substance, distal migration of the graft may occur when the patient is vertical, resulting in distal consolidation, but no proximal consolidation. When greater mechanical strength is desired, particularly at the supracondylar level, where the femoral diameter increases, a double-barrel assembly[7,8,17,18] with one or two fibula[6] can be performed. In addition to increasing stability, this double-barrel assembly theoretically reduces the risk of stress fractures.[19] In our series, we made seven double-barrel assemblies. Two of these patients (28%) presented with a fibula flap fracture, including one patient who also had a recurrence of infection, for which the free flap was probably no longer vascularised.

The fibular flap also becomes the first-line technique when the loss of substance is such that the capacities of a nonvascularised bone graft appear to be exceeded. As in the literature, we will not reserve this indication for substance losses greater than 6 cm, or for reconstructions in unfavorable, poorly vascularised or septic environments.[20,21] Regarding bone consolidation, we found in our cohort a consolidation rate of 92.3% and a delay of 7.6 months, which is consistent with the literature.[4] Only two patients did not heal and required urgent revision surgery due to a major displacement with dismantling of the fixation, leading to the removal of the fibula flap, followed by the placement of cement to perform a first-step Masquelet.

Vascularisation and Flap Monitoring

In a study published in 2003, Pelissier et al.[22] analysed the results of bone reconstructions in the lower limb by bone graft, vascularised or not. They found a higher rate of union for vascularised bone grafts, but a longer time to union of 2 months compared with non-vascularised grafts. However, vascularised bone grafts were reserved for septic contexts in their series, probably explaining this longer delay. If the blood supply is interrupted, the graft behaves like a classic cortico-cancellous graft.[23]

In our study, we excluded the fibula flaps associated with a skin paddle because primary closure at the level of the femur is easy. Moreover, the skin paddle is close to the fibula, so it is technically more difficult to externalise it as the soft tissues of the thigh are

Table 3: Consolidation rate, functional outcomes and presence of fibula flap fracture postoperatively

Patient	*Consolidation (in months)*	*Weight-bearing resumption (in months)*	*Fibula hypertrophy in % at 1 year*	*Fibula hypertrophy in % at 2 year*	*Walking perimetre (metres)*	*Fibula fracture*
Patient 1	9	6	0	12	300	No
Patient 2	10	9	0	14	500	No
Patient 3	7	6	9	21	500	No
Patient 4	12	10	0	11	Unlimited	No
Patient 5	5	5	15	49	500	No
Patient 6	7	6	0	15	Unlimited	No
Patient 7	7	6	21	51	Unlimited	No
Patient 8	11	9	0	33	1000	No
Patient 9	8	6	17	30	Unlimited	No
Patient 10	9	7	0	26	Unlimited	Yes
Patient 11	6	5	15	35	Unlimited	No
Patient 12	6	5	0	17	250	No
Patient 13	5	5	17	45	Unlimited	Yes
Patient 14	15	9	0	20	Unlimited	No
Patient 15	6	5	19	43	Unlimited	Yes
Patient 16	8	8	25	44	1000	Yes
Patient 17	6	6	13	35	1000	Yes
Patient 18	7	6	12	32	Unlimited	Yes
Patient 19	9	9	5	20	500	No
Patient 20	6	6	8	28	Unlimited	Yes
Patient 21	Never	Never	Non-evaluated	Non-evaluated	Non-evaluated	Yes
Patient 22	Never	Never	Non-evaluated	Non-evaluated	Non-evaluated	Yes
Patient 23	6	6	0	17	Unlimited	No
Patient 24	6	6	0	15	1000	No
Patient 25	5	5	16	30	Unlimited	No
Patient 26	7	5	11	28	Unlimited	No

much thicker than those of the fibula. In addition, even in the case of a skin paddle used as a control, it appears that the suffering of the skin paddle does not necessarily imply the suffering of the underlying fibula.[24,25] In our practice, we carry out a simple clinical monitoring of free fibula flaps.

Several studies[25–27] have reported no loss of graft, despite the occurrence of complications such as vascular thrombosis or skin pallet necrosis in the case of composite grafts. This suggests that the notion of consolidation is not sufficient to qualify the success of the vascular transfer, and the notion of time to consolidation is at least as important as the rate of consolidation.

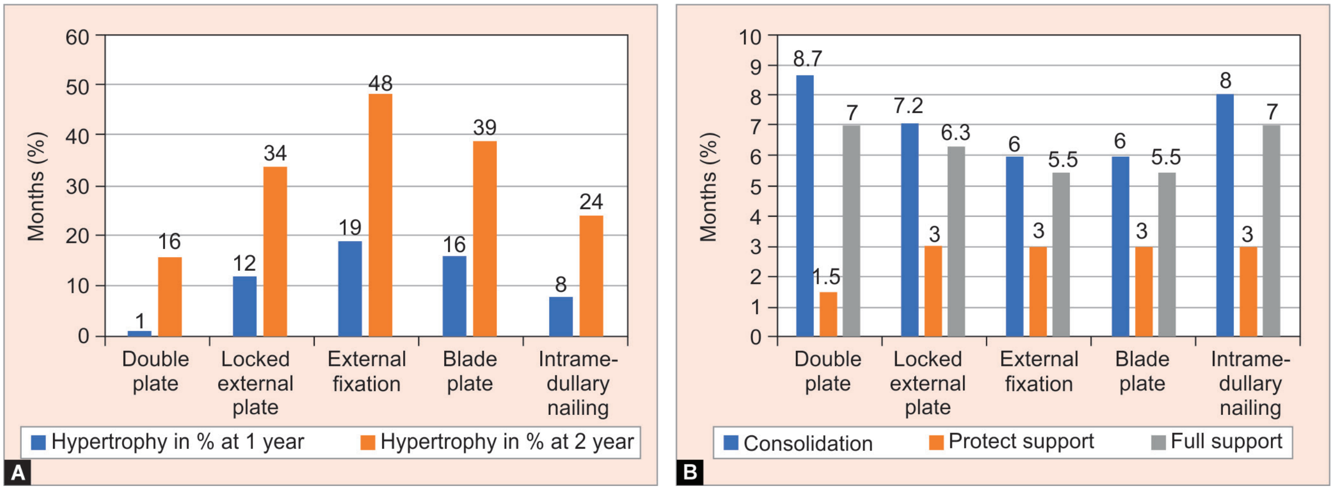
Han et al.[28] systematically performed scintigraphy in the first postoperative week. The scintigraphy was fixed in 76% of cases. Likewise, Mattar et al.[29] found only one failed union in the only patient with a negative scan. Scintigraphy thus represents a prognostic factor, which, despite being unable to carry out an emergency recovery, makes it possible to adapt the time to weight-bearing resumption and the intensity of the physiotherapy.

Bone Fixation

Regarding bone fixation, intramedullary nailing also poses the problem of the size of the femoral shaft, which makes it impossible to embed the fibula. The risk of septic conditions, especially pandiaphysitis, may also limit the indication. No secondary dynamization was performed, and no graft fracture was observed. However, the time to union was relatively long (8 months), and the rates of hypertrophy were modest (8% at 1 year 24% at 2 years).

The external fixator poses the problem of random control of the reduction, progressive septic risks from the pins, secondary displacement due to a lack of rigidity of the hardware and stiffness of the knee associated with the quadriceps transfixion. In a reconstructive surgery context, it remains interesting because external fixation does not require the installation of internal equipment in a very often-septic environment, but its foreseeable maintenance for a minimum period of 1 year can be a poor experience for the patient. In our practice, the loss of mediodiaphyseal substances of the femur was treated with a monobar external fixation, while the loss of metaphyseal substances was treated with a periarticular hybrid external fixation. Here, union was acquired within 6 months, and the hypertrophy rates were particularly encouraging (19% at 1 year and 48% at 2 years). For these two patients, the stiffness of the knee was no greater than that seen in the other patients in the series. The blade plate allows an anatomical and relatively stable fixation, making an immediate mobilisation possible, but without weight-bearing. The absence of locking of the cortical screws enables a natural axial dynamisation to be obtained. This type of fixation was used twice in our series. The time to union was 6 months, and both patients presented stress fractures. Only one had to be taken for the addition of a DCP-type plate and conventional cancellous bone graft. The hypertrophy rates here were 16% at 1 year and 39% at 2 years.

For the locked plates, the primary stability of the material is independent of friction and bone quality and allows respect for the periosteum to be maintained. Four patients (44%) presented a graft fracture. In this group of patients fixed by a locked plate, the



Figs 2A and B: Hypertrophy, consolidation and weight-bearing resumption depending on the type of bone fixation

mean time to union was 7.2 months, and the rate of hypertrophy at 1 year was 12% and at 2 years was 34%.

The most practiced synthesis is currently that by double plate, adding to the fixation by a locked plate, and a second locked plate that is anterior for losses of substance from the mid-diaphyseal seat, and internal for losses of substances from the supracondylar seat. This ensures much greater stability during assembly, or even rigidity; the corollary is that when dismantling occurs, the damage caused can be major. None presented a stress fracture, but we were confronted with two cases of massive hardware dismantling at 1 year (18%) for which a surgical revision was necessary with no conservable graft. In addition to these two patients for whom no union has ever been observed, it appears that the time to union is the longest in this series with an average of 8.7 months. The rates of hypertrophy are lower, namely 1% at 1 year and 16% at 2 years. The initial goal of this additional plate was faster recovery and a lower incidence of stress fractures. Even if weight-bearing was actually started at 6 weeks, it appears that full recovery was the latest (7 months). Contrary to our initial hypothesis, it seems that double plates provide an overly rigid means of fixation, with a risk of major complications requiring revision surgery but also with a lower rate of hypertrophy. In our practice, we have abandoned fixation by double plates because, according to Wolff's law, tension and compression cycles create a small electrical potential that stimulates bone deposition and increases density at points of stress. We recommend external fixation or the use of locked plates.

The occurrence of a stress fracture on the fibula bone graft is the most common complication encountered in this type of procedure. Its incidence is estimated to be between 24% and 40% depending on the study,[4,25,27,30] with an average delay of 9 months when full weight-bearing is allowed.

Various studies have failed to establish a link between the length of the transplanted fibula and the appearance of a stress fracture, as in our series. We found that graft hypertrophy at 2 years is greater when a stress fracture occurs (36.1% (26–45%)) than in its absence (24.6% (11–51%)).

As discussed previously, it appears that the choice of internal fixation plays an important role, and the increase in rigidity of the fixation decreases the risk of a stress fracture while also decreasing the hypertrophy of the fibula.[31] Finally, among the seven patients who presented with a fatigue fracture, only two (28.5%) required revision surgery.

Limitations and Personal Opinions

There are some limitations regarding our study. Although our cohort is the largest ever published in the literature, it only represents a very targeted population: reconstructions in a traumatic context. This explains the relatively small size of our sample, even though there are many larger series concerning oncological resections,[32] while none of them specifically concern traumatic loss substances. Another criticism that can be made of our study is that we focused on weight-bearing resumption and walking perimetre as functional data. Hip and knee range of motion was not collected.

Due to the small population of our series, the significant heterogenicity in the sample, the types of substance loss and the methods of fixation, it is difficult to determine the optimal bone fixation technique, so it is therefore important to carry out a new study, ideally multicentric, in order to collect the greatest number of cases, making it possible to compare homogeneous subgroups to confirm or refute our results. However, to our knowledge, there are no studies comparing the means of bone fixation in femoral reconstructions. Our practice and our experience have led us to abandon fixations that are too rigid and do not allow for optimal bone consolidation, with catastrophic complications in nearly a quarter of the cases. With the advent of locked plates and our experience, we recommend this type of fixation, especially when no sepsis has been found. In other cases, the external fixator seems to be a safe and efficient solution, although very cumbersome for the patient. The risk of fracture: Although the risk of fibular fracture is greater than with double plates, it is interesting to note that less than one-third of these fractures (only two in our cohort) required revision surgery, and surprisingly, the flaps that had undergone surgical fracture appeared to have better hypertrophy than those that had not. All of these arguments mean that in our practice, we will favour locked-plate fixation over double-plate fixation. Although blade plates offer interesting results in terms of resumption of support, speed of consolidation and also in terms of flap hypertrophy, we have only performed it twice, which is too little to draw any real conclusions.

Conclusion

Free fibula flap remains reliable in the face of a great loss of bone material after trauma, with high consolidation rates. The choice of fixation must be reasoned and should offer a compromise between stability, allowing consolidation and hypertrophy of the graft, and rigidity exposing the risk of massive dismantling. Our retrospective study confirms the reliability of free fibula flaps in femoral bone reconstruction, and our results are consistent with those in the literature.

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