Clinical Study

Donor-site complications of autogenous nonvascularized fibula strut graft harvest for anterior cervical corpectomy and fusion surgery: experience with 163 consecutive cases

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Abstract

BACKGROUND CONTEXT: The fibula is a source of bone graft for reconstruction of the appendicular and axial skeleton.

PURPOSE: The aim of this study is to determine donor-site complications and morbidity in a large series of patients who underwent autogenous fibula harvesting for anterior cervical corpectomy and fusion (ACCF) surgery.

STUDY DESIGN/SETTING: Retrospective review (Level III).

PATIENT SAMPLE: One hundred sixty-three patients over an eight-year period who underwent ACCF with autogenous fibula.

OUTCOME MEASURES: Donor site complications (such as infection, cellulitis, pain, damage to the superficial peroneal nerve, ankle instability, tibial stress fracture, and so forth), treatment, and final outcome were determined from patient records.

METHODS: Retrospective study of patients who underwent ACCF with autogenous nonvascularized fibula strut graft over an eight-year period (from 1995 to 2002) was conducted. Donor site complications (such as infection, cellulitis, pain, damage to the superficial peroneal nerve, ankle instability, tibial stress fracture, and so forth), treatment, and final outcome were determined from patient records.

RESULTS: One hundred sixty-three patients underwent ACCF with autogenous fibula graft during the study period. The most common short-term complication (lasting < 3 months) was incisional pain, present in 86 of 163 patients (53%). Incisional pain lasted longer than 3 months in 25 of 163 patients (15%) but resolved in all but two patients by 24 months. Two patients (1.2%) developed superficial peroneal neuromas. Five patients (3%) developed tibial stress fractures. Two patients (1.2%) developed ankle instability. Fifteen (9%) patients developed cellulitis that resolved in all patients after a short course of oral antibiotics, with one additional patient developing a deep infection requiring surgical debridement and intravenous antibiotics.

CONCLUSIONS: Although autogenous fibula is an excellent graft for multilevel ACCF reconstruction, surgeons should carefully consider the associated morbidity of fibular harvest before surgery. In this series, most complications were of short duration. However, nine patients with long-term complications required five additional surgical procedures. Therefore, patients who are scheduled to undergo autogenous fibula harvest should be advised about these potential complications.

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Introduction

The fibula can be a source of bone graft for reconstruction of the appendicular and axial skeleton [1–3]. However, harvesting autogenous fibula may lead to donor-site complications, such as pain, injury to the superficial peroneal nerve, infection, tibial stress fractures, and ankle instability [4–7]. The incidence of such complications has been reported in the literature to range from 40% to 57.7% [8,9]. However, most such reports have a small cohort size, ranging from 10 to 104 patients [8,9]. Therefore, there is a need for studies with larger numbers of subjects so that the incidence and scope of these complications can be more fully understood and appreciated.

Most of the reports on this subject have focused on vascularized fibula harvest for the treatment of avascular necrosis of the femoral head [10,11]. The literature on complications from fibular strut grafting for anterior spinal reconstruction has concentrated more on complications at the recipient site than the donor site [12–14]. However, to our knowledge there is no study in the literature that has exclusively studied the incidence and types of complications at the donor site when nonvascularized fibula (used simply as a strut graft) is harvested for anterior cervical corpectomy and fusion (ACCF) surgery.

Methods

This was a retrospective study of patients who underwent ACCF with autogenous nonvascularized fibula strut graft by the senior surgeon (JDK) over an eight-year period (1995–2002). Patients who had incomplete records or those who had a history of trauma to the lower extremities were excluded. Most of the patients presented with cervical myelopathy with compression of the spinal cord spanning two or more vertebral bodies. Autologous fibula was used as a strut graft if the patient required two or more level corpectomies and patients were immobilized postoperatively in a rigid cervical collar. Most patients underwent noninstrumented fusion (161 patients), two patients had anterior cervical plating and one patient had postoperative halo immobilization (Table 1).

In all instances, a direct lateral incision was used to harvest a portion of the middle one-third of the fibula. Care was taken to identify and protect branches of the superficial peroneal nerve, tension, tibial stress fractures, and ankle instability [15]. The fibula was used strictly as a strut graft, as previously described [15]. Patients were allowed to bear full weight as tolerated with the use of a walker postoperatively if necessary.

Donor site complications (such as infection, cellulitis, pain, damage to the superficial peroneal nerve, ankle instability, tibial stress fracture, and so forth) were identified from the patient records. The type of complication, treatment, and final outcome were determined. Final patient outcome was noted.

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Results

A total of 163 patients underwent ACCF with autogenous fibula graft during the study period. Average patient age was 54.9 ± 11.8 years old (range, 31–84). Most of these patients had either two- or three-level corpectomies, with an average of 2.4 ± 0.5 levels (range, 2–4). Donor-site morbidity was further classified into either short-term (<3 months postoperatively) or long-term (≥3 months postoperatively; Table 2).

Short-term complications

The most common short-term complication was incisional pain at the donor site for up to 3 months postoperatively (86 of 163 patients; 53%). Fifteen (9%) patients developed cellulitis that resolved in all patients after a short course of oral antibiotics. Deep infection developed in one patient, who required irrigation/debridement and intravenous antibiotics. All patients in the short-term complication group had no further sequelae after resolution of their symptoms.

Long-term complications

The most common long-term complication was incisional pain lasting more than 3 months (25 of 163 patients; 15%). Only eight patients (5%) had pain lasting greater than 12 months and of these, the pain resolved in all but two patients at 24 months. Two patients (1.2%) developed superficial peroneal neuromas that were treated conservatively. One resolved completely within 6 months, whereas the other patient had resolution of most symptoms with minimal residual discomfort at 24 months postoperatively. Two patients (1.2%) developed lateral ankle instability. One was treated nonoperatively with an ankle brace, whereas the other required a Brostrom lateral ankle ligament reconstruction.

Five patients (3%) developed tibial stress fractures. Their postoperative courses were as follows:

- Two patients with tibial stress fractures were treated with a brace and protected weightbearing. Both healed uneventfully after 3 months of treatment.
- One patient was initially treated in a brace and protected weightbearing for a nondisplaced midshaft tibia fracture but because of noncompliance, a second fracture developed in the distal tibia. This second fracture propagated into a complete fracture. He required operative stabilization with an intramedullary nail and went on to bone healing at 12 months postoperatively. His clinical course is depicted in Fig. 1.
- One patient with rheumatoid arthritis developed a tibial stress fracture that rapidly progressed to a complete transverse fracture. She was initially treated in a cast but developed skin necrosis. The fracture required an intramedullary nail for stabilization followed by free tissue transfer to cover the skin defect. She went on to bony union at 6 months postoperatively.
- One tibial shaft fracture developed in an elderly woman who had complained of leg pain but had shown no evidence of stress reaction or fracture on plain radiographs. She subsequently suffered a low energy fall. The fall resulted in a midshaft tibial fracture with a butterfly fragment laterally. It is uncertain whether this final case represented an avoidable result of fibula graft harvest. She required an intramedullary nail for stabilization. She went on to bony union at 4 months postoperatively.

Discussion

Reconstruction of the anterior cervical spine after discectomy or corpectomy can be performed with either an
allograft or autograft [16]. Experience with both types of bone graft in the literature suggests that autograft may be associated with higher rates of union as compared with allograft [17,18]. For single-level anterior cervical decompression and arthrodesis, autogenous iliac crest bone graft is considered by many to be the gold standard [16]. For multilevel anterior vertebrectomy and fusion, fibula strut graft (either allograft or autograft) can be used. In

Fig. 1. Clinical course of a patient with a tibial stress fracture after anterior cervical corpectomy and fusion (ACCF) C3–C6. (A) Patient complained of leg pain at 3 months. (B) Patient diagnosed with stress fracture of the midshaft tibia at 10 months. (C) Patient was noncompliant with bracing and casting and was diagnosed with another tibial stress fracture at 14 months. D, E Patient was healing original fracture but completed second tibial fracture at 15 months and was then treated with intramedullary nailing. (F, G) Intramedullary nailing of tibial fracture at 19 months after ACCF. (H, I) Healed tibial fracture at 36 months after ACCF.
a study of 126 patients, Fernyhough et al. found that using an autogenous nonvascularized fibula strut graft was associated with lower nonunion rates compared with allograft fibula (27% vs. 41%) [19]. The choice of autograft versus allograft depends on surgeon experience, the numbers of levels being treated, patients’ concerns about potential donor-site morbidity, and other coexisting medical conditions.

Most of the literature on autogenous fibula harvesting comes from experience with vascularized fibula for the treatment of avascular necrosis of the femoral head [8,20,21]. To our knowledge, the present study is the largest of its kind to specifically study nonvascularized autogenous fibula harvest for anterior cervical spine reconstruction to be used strictly as a strut graft. In contrast to vascularized fibula harvest, nonvascularized autogenous fibula harvest does not entail meticulous dissection to preserve the vascular pedicle. Hence, the harvest process is technically less demanding. Although there are reports of vascularized fibular strut grafts being used during spine fusion [22,23], today most surgeons use nonvascularized fibula strut grafts for this purpose [24]. Using autogenous nonvascularized fibula strut grafting for anterior cervical spine surgery has demonstrated good clinical results [25].

Autogenous fibula harvesting is associated with significant morbidity [4,6,7,21]. Tang et al. reported their experience with 39 patients who underwent free fibular grafting for femoral head avascular necrosis [21]. In this series, the most common patient complaint was subjective instability (42%) that could not be reproduced under objective clinical examination. Although they did not have any neuramas, 16% of patients did complain of paresthesias. Most patients healed the donor-site wounds without any problems; however, 16% had delayed wound healing. One patient required a reoperation to release a contracture of the flexor hallucis longus. There have been reports in the literature suggesting that the fibula has weightbearing function and that its resection may result in potential instability [8,26]. Babhulkar et al. reported that six of the 104 patients in their series developed ankle instability that was demonstrable on physical and radiographic examinations [8]. In our study, two patients had this complication, one of which subsequently required a ligamentous reconstruction procedure. Therefore, patients should be advised about this potential complication preoperatively.

Some authors have noted that, after autogenous fibular harvest, patients develop clinically notable weakness of the toe flexor and extensor muscles. In their series of 39 patients, Tang et al. reported that 14 (37%) had subjective complaints of weakness [21]. However, only five of these 14 patients had clinical weakness with objective muscle strength testing. Similarly, Lee et al. studied 10 patients and noted that three of them demonstrated postoperative weakness of the long toe flexors and extensors [9]. Disruption of the interosseous membrane is proposed to be the mechanism by which such weakness results. Using gait analysis, Youdas et al. showed an inverse relationship between amount of resected fibula and ankle evertor strength [27]. However, their follow-up showed normalization of gait abnormalities after longer follow-up, which may indicate that, at least in terms of weakness, this complication may be overcome with time. In our study, we did not perform formal muscle power testing, and therefore we cannot comment on how many patients had this complication in our study population.

The five tibial stress fractures (3% of the patients) reported here is a higher rate than other reports in the literature that consist mainly of case reports [28–31]. In light of the suggested weightbearing role of the fibula [32,33], we speculate that subclinical weakening as a result of fibula graft harvest was contributory to these fractures. The patient with rheumatoid arthritis who experienced the most severe of the complications in this series most likely did so because of the severity of her underlying disease. Therefore, we suggest refraining from harvesting the fibula from patients with rheumatoid arthritis or other organic conditions that may affect the underlying strength of bone (steroids, osteoporosis, and so forth). We did not specifically assess the increased risk in harvesting fibula in patients with underlying metabolic disorders of bone (diabetes mellitus, rheumatoid arthritis, osteoporosis, corticosteroid usage, and so forth) in this study because of the relatively small patient cohort available. A larger, multicenter analysis may provide sufficient power to demonstrate the increased relative risk of patients with metabolic bone conditions and risk factors for osteoporosis/osteopenia (age, gender, and so forth).

The findings of the current study, along with recent developments in spine implant technology, have implications on surgical planning and techniques. The senior author (JDK) has slowly moved away from using autograft fibula and does not recommend using autograft fibula as a stand alone fusion not only because of the complications that have been noted in this study, but also because of the recent development of more effective posterior instrumentation to help augment spinal fusions. The role for fibular autograft in anterior cervical spine surgery may be more limited in the future.

Although autogenous fibula is an excellent graft for multilevel ACCF reconstruction, the surgeon should carefully consider the associated morbidity of fibular harvesting before planning this procedure. In this series, most of the complications were of short duration. However, nine patients with long-term complications required five additional surgical procedures. Therefore, patients who are scheduled to undergo autogenous fibula harvest should be advised about these potential complications.

References


