

“Double stacked” plate fixation at the proximal allograft-host bone interface following segmental resection for malignant bone tumors

Background

Malignant bone tumors of the proximal femur often require large resections that create troublesome allograft reconstructions. Proximal resections generate high offset distances between the mechanical and anatomical axis resulting in increased bending and shearing forces at the junction interface. This frequently causes catastrophic failure of the fixation.

Questions

Can double stacking the plate fixation at the proximal allograft-host bone interface prevent catastrophic failure prior to union? How proximal from the knee joint is it necessary to double stack plates? Does augmenting the construct with cerclage wires add strength? Is double stacking plates necessary for vascularized fibular augraft reconstruction?

Patients and Methods

There are two groups of patients in this case series. Each patient had a malignant bone tumor segmental femoral resection followed by intercalary reconstruction. The first group of 6 patients had with reconstruction using fresh frozen allograft combined with vascularized fibular graft. The second group of 5 patients had reconstruction using intercalary allograft alone.

Three types of junction interfaces are described.

1. Distal metaphyseal/metaphyseal junction is exposed to lower bending and shearing stresses, have a broader allograft-host bone interface, and have superior vascular supply.
2. Distal diaphyseal/metaphyseal junction have intermediate biology and mechanics.
3. Proximal diaphyseal/diaphyseal junction have less interface surface area, hard cortical bone with poor blood supply, and higher shearing and bending forces.

Results

In both groups, the distal junction healed with no complications. The proximal junction healed completely in all patients with combined allograft vascularized fibular graft reconstruction. In four out of five patients with allograft only reconstruction the proximal junction did not unite and eventually the plate fixation failed. After revision fixation with Double stacked plating, the 4 patients went on to unite the proximal allograft-host bone interface.

Conclusions

Combined allograft and vascularized fibular graft reconstruction in segmental femoral resections proved to be the gold standard reconstruction with complete union in all patients. The proximal femoral diaphyseal/diaphyseal junction is exposed to high bending and shearing forces, and has a poor biological environment for allograft-host bone union. These proximal junctions should be reinforced with double stacked plating in order to give the junction more time for union prior to fatigue failure of the implant. Femoral proximal diaphyseal/diaphyseal allograft host bone junction may take years until complete healing, making adequate long term fixation mandatory.

