IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 15, Issue 4 Ver. VII (Apr. 2016), PP 01-04
www.iosrjournals.org

Incorporation of Allogenous Fibular Graft in Pediatric Humerus following Segmental Resection.

Jeya venkatesh Palanisamy[1] MS Ortho., Dip SICOT.,
R.Balachandran[2] MS Ortho., D.Ortho.,
[1]*Senior resident, Department of Orthopaedics, All India Institute of Medical Sciences, New Delhi, India.*
[2]*Professor of Orthopaedics, Government Royapettah Hospital, Chennai, India.*

Abstract : *Allogenic bone grafts are used to fill bone defects following tumor resection. We report a case treated by segmental resection of humerus and allogenous bone grafting at five years of age and followed up till skeletal maturity. Five year male child with recurrent fibrous dysplasia of left humerus was treated with excision and allogenic non vascularised fibular grafting. The graft has incorporated well at five years follow up and remodeled to the contour of the bone subsequently, at fourteen years follow up patient is disease free with normal range of movements with shortening. Incorporation and remodeling of the allograft in the paediatric patients is discussed.*

Keywords: *Non-vascularised graft, Humerus, Fibrous dysplasia, Segmental bone loss, Fibular strut.*

I. Introduction

Non vascularised fibular graft has been well accepted for reconstruction following long bone defects. Very few reports are available on long term follow up of fibular grafting in following segmental resection of humerus in pediatric population[1]. We are reporting a case where allogenous fibular graft had been used following segmental resection of humerus in a child and was followed up till skeletal maturity.

II. Case History

Four years old boy presented with features of monostotic fibrous dysplasia of left proximal humerus. Histopathological examination confirmed the diagnosis of fibrous dysplasia. The patient had persistent pain in spite of analgesics and splinting. Range of movements around shoulder and elbow were painfully restricted at extreme movements. Following failed conservative therapy, surgery was undertaken. Through deltopectoral approach curettage done and allogenous cancellous graft taken from his mother's iliac crest was used for grafting [Figure 1]. Post operative period was uneventful, pain free and regained full range of movements. At the end of one year the boy presented with moderate to severe pain in arm with radiological findings of resorption of bone grafts and recurrence of lytic lesion [Figure 2].

Figure 1: Fibrous dysplasia left humerus.
Immediate post-operative radiograph after curettage and bone grafting.
Figure 2: Radiograph showing recurrence following curettage and bone grafting at one year follow-up.

Since lesion was extensive involving more than half of humeral shaft with cortical thinning with pain and functional restriction and posing risk of pathological fracture, he was planned for excision and reconstruction of the defect. Through anterolateral approach, segmental resection of pathological bone was done and the metadiaphyseal defect found to be about 8 centimeter (cm). At the same time through lateral approach fibula graft harvested from his mother was used as cortical strut with excess bone telescoped into normal medullary canal and fixed with three 3.5 millimeter (mm) cortical screws distally [Figure 3].

Figure 3: Radiograph following segmental resection and allogenous fibular grafting.

Cancellous bone grafts were packed at either end of graft. Post operatively patient was protected with slab. Passive motion started as pain subsided. Active mobilization started at 8 weeks after radiological evidence of union. Follow up done clinically and radiographically at periodic intervals. Patient was allowed to return to normal activities after six months. Patient was asymptomatic with normal range of movements at shoulder and elbow at one year. The graft has partially incorporated at two years [Figure 4] with good functional outcome [Figure 5] and completely incorporated at the end of five years [Figure 6] further follow up revealed remodeling of the graft to the contour of the bone.

Figure 4: Radiograph at two years follow up showing partial graft incorporation.
Figure 5: Full range of movements at two years follow up.

On fourteen years follow up there is six centimeters shortening in the affected arm [Figure 7a]. Patient has full range of movements with grade 5 muscle power (MRC grading). Range of movements at left shoulder is forward flexion 0- 160°, extension 0- 60°, internal rotation 0-70°, external rotation 0-100°, abduction 0- 170°, adduction 0-50° . Radiography shows consolidation and remodeling of allograft to host bone [Figure 7b]. There is no evidence of recurrence or malignant change.

III. Discussion

The lesions of fibrous dysplasia develop during skeletal formation as a result of a developmental failure in the remodeling of primitive bone to mature lamellar bone and a failure of the bone to realign in response to mechanical stress[2]. The humerus is the third most common site for this benign space-occupying lesion after the distal femur and the proximal tibia[3]. Our diagnosis in initial presentation was based on clinical findings of pain, radiological features of ground glass appearance, endosteal scalloping and distinct rim of reactive bone surrounding the lesion. In newly identified cases, a bone scan is needed to exclude a diagnosis of polyostotic disease[2] but considering the absence of other clinical features we have not taken bone scan and kept the patient under constant observation. Bisphosphonates might reduce disease activity and alleviate pain in fibrous dysplasia but we have not used in our case. Curettage and cancellous bone grafting was done in our case after failed conservative measures. We subperiosteally resected the lesion and kept the segment of resected mother's fibula into the humeral medullary canal. Among the various options available for biological reconstruction following segmental bone resection like bone transport, vascularised bone transfer, allograft (live and cadaveric graft), we used mother's fibular allograft. The modes of obtaining stability following cortical bone grafting are graft impaction alone [1], intramedullary nailing, plate and screw fixation, and fixation with screws alone. In general segmental resection needs rigid stabilization but as the graft snugly fitted into the canal and found stable intra operatively, only three screws were used to stabilise the cortical allograft and the distal humeral cortices, to achieve a so-called Quadricortical fixation [3].

Figure 6: Radiograph at five years follow up showing graft incorporation.
Figure 7: Twelve years follow up showing shortening of 6 centimeters (a) and x-ray showing complete graft incorporation and remodeling (b).

Non-vascularised bone grafts have been used for more than 100 years, particularly for reconstruction after resection of a bone tumour. The first description of their use was in 1911[4]. In pediatric age group due to immature nature of donor bone and because of anticipated donor site morbidities, allogenic grafts are preferred. Few studies have used autogenous fibular graft even from skeletally immature patient and showed good results without major donor site morbidities [1]. Vascularised grafts should be used primarily in the segmental bone loss in lower leg and the forearm and when stabilization is difficult, such as when the defect is within the epiphysis very close to the joint [4]. Cortical grafts, used to replace curetted cavities are inserted through dysplastic lesions to strengthen them against fracture, persist much longer than do cancellous grafts. In the normal repair of a cortical bone graft, only the osteonal portion (approximately 50% of the graft) is replaced by dysplastic host bone, whereas the interstitial lamellae (the remaining 50%) are not replaced and persist [2]. Because cortical allogeneic grafts have the least and slowest internal replacement by host bone, more of the graft persists for longer. Placing the allogenous cortical struts intramedullaryly facilitated union because of the large contact area between the cortical strut and the endosteal surface of the humerus [3].

The good blood supply of the recipient bed in the proximal humerus allows revascularization of the fibular graft. In the first few weeks post-operatively the mechanical strength of the graft is reduced during which period the limb has to be protected adequately [5] without allowing mechanical load. Healing of the allograft struts to the adjacent host bone reduces the mechanical demands on the struts. The intramedullary cortical struts provide sufficient stability to the lesion site by acting as an internal splint, while simultaneously functioning as an osteoconductive material. This technique may not be as successful in treating long bone defects of the lower limbs, where the mechanical demands of the long bones are relatively high [3]. The full mechanical properties return after 6 to 12 months [1].

During follow up we evaluated graft incorporation and remodeling. Allograft incorporation into the host bone was considered complete if the graft outline was completely obliterated. Incorporation was considered partial if the graft was still visible but its border was blunted and no incorporation if the contour of the allograft was unchanged from that of the initial postoperative radiograph [3]. In our case the borders of the graft started obliterating at the end of two years; graft outline was completely obliterated at five years follow up. Factors that can influence the incorporation of the allogenous cortical struts are patient age, defect size, allograft length, and supplementary autogenous or allogenous cancellous bone graft [3]. Bone healing between the ends of the host bone and allograft occurs three to ten months after the operation [1, 3-4]. Shortening of 2 to 6 cm were reported in literature [1] in humerus following skeletal reconstruction. Our patient has six cm shortening at skeletal maturity probably due to the involvement of proximal humeral growth plate. The contour of the bone, diameter of the bone were compared with contralateral humerus, the graft hypertrophy is evident on follow up which is usually less common in upper limbs than mechanically loaded lower limbs. Except for shortening, the remodeled bone is identical in its physical dimensions as that of unaffected side.

IV. Conclusion

Allogenic cortical bone grafts from live donor for humerus bone defects provide both structural support and render biological property without graft related complications. Incorporation and remodeling of the graft occurs in the paediatric patients to match the contour of normal bone and provides good functional result.

Footnote

The case reported above is from Government Royapettah Hospital, Kilpauk Medical College, Chennai.

References

[1]. Hsin-Nung Shih, Lih-Yuann Shih, Chun-Ying Cheng,Kuo-Yao Hsu, Chung-Hsun Chang. Reconstructing Humerus Defects after Tumor Resection using an Intramedullary Cortical Allograft Strut. Chang Gung Med J 2002;25:656-63.

[2]. DiCaprio MR, Enneking WF. Fibrous dysplasia. Pathophysiology, evaluation, and treatment. J Bone Joint Surg (Am) 2005;87-A:1848-1864.

[3]. Andrzej Grzegorzewski, Ewa Pogonowicz, Marcin Sibinski, Marek Marciniak, Marek Synder.Treatment of benign lesions of humerus with resection and non-vascularised, autologous fibular graft. International Orthopaedics (SICOT) 2010;34:1267–1272

[4]. A. H. Krieg, F. Hefti. Reconstruction with non-vascularised fibular grafts after resection of bone tumours. JBJS (Br) 2007;89(B):215-221

[5]. S.K. Nandi, S. Roy, P. Mukherjee, B. Kundu, D.K. De & D. Basu. Orthopaedic applications of bone graft & graft substitutes: a review. Indian J Med Res 2010;132:15-30