CRITICAL ANALYSIS OF AUTOGENOUS BONE GRAFTS IN HAND SURGERY – A REVIEW OF 24 PATIENTS

Plastic Surgery

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ABSTRACT

Introduction: The need for smaller grafts & requirement of articular surfaces makes the bone grafting in hand surgery challenging.
Materials and Methods: All successive patients who underwent autogenous bone grafts for acquired bone gaps in hand in 2 years were studied.
Results: 24 cases were studied where cause of defect was trauma (71%) & tumour (29%). The productive age group individual had more such defects (62.5%). The grafted bones were Metacarpals (38%), proximal and middle phalanx (17%) each, terminal phalanx (4%) and for the osteoplastic reconstruction of thumb (25%). Non vascularized grafts for 92% & vascularized grafts in 8% cases were used. Monocortical grafts were used in 50% while segmental (17%), cancellous (12%), and articular grafts (21%). The bone graft survival was 96% in all.
Discussion: The challenge of grafting smaller bone gaps revealed interesting findings. Monocortical grafts were sturdy, lasting and easier to harvest providing the most viable option for bone defects of hand. Bone grafts under a pedicled flap cover tend to get more resorbed than with vascularized or with islanded flap.
Conclusion: The bone grafting for smaller defects of hand bones need meticulous planning and timed execution.

KEYWORDS

Bone Grafting, Monocortical grafts, small bone defect

INTRODUCTION

Skeletal restoration is an essential aspect of composite wound management [1]. Bone grafting is usually used to reconstruct cysts and defects arising due to trauma, tumor or infection ablation and to achieve joint arthrodesis the hand. Bone grafts have osteogenic, osteoinductive, and osteoconductive properties that induce healing [2]. This axiom holds for the bone defects for the hand too but there is additional challenge due to the small size of the bony defects and future recovery of the dexterity of hand function. Many a time the hand surgeon is also burdened with problems of limited approach to exposure of the defect, fixation of such small bone grafts, and post-operative mobilization schedule to regain the effective function of the affected hand. In addition the compact anatomy of hand and the limited studies to such bone grafting pose difficulties when planning and approaching the reconstruction of a bony defect in the hand.

Hence a study was designed to study the patients on whom a procedure of a bone grafting was performed for any acquired defects of long bones of hand, distal to carpal bones, to determine the type and longevity of the bone graft with an ulterior aim of devising an algorithm

MATERIALS AND METHODS

All patients who were managed with autogenous bone grafts for acquired bone gaps in hand over a period of 2 years were included in the study and a critical analysis was performed with a periodic (3 monthly) follow up for upto 2 years from the procedure.

The inclusion criteria were
All patients, in whom a bone graft was placed for the bone gaps in the long bones of hand, distal to carpal bones, were included.
The exclusion criteria
*   Patients with bone gaps or grafts involving carpals and wrist
*   Congenital defects
*   Bone grafts for arthrodesis

Design
Consent:
All the patients within the inclusion criteria were explained about the study and included only after consent.

Surgery:
The choice of grafting, techniques of the surgery, post op mobilization and mandatory follow up were as per the protocols of the reconstructive centre and not influenced due to the study. As the successive cases were included, no randomization was required and no ethical issue jeopardized.

Standard Proforma
A performa was designed which included besides the patient demography, the etiology of the defect, size of the defect, region of involvement, mode of reconstruction, type of bone graft (i.e. cortical, corticocancellous, cancellous), vascularized or non-vascularized, with or without articular surface, donor bone, complications in the grafted site or the donor site, donor site morbidity, return to function, long term survival (2 years) of bone graft and patient satisfaction.

RESULTS
Total: A Total of 24 patients were included in the study in the defined 2 years period.

The analysis of the patients in the study yielded following data
a) Age Range: (Tab 1) Predominant individuals were in the productive age group of 20-40 (62.5%) whereas the 40 -60 age group were 29 % only.

Tab 1: Age Range

S NO	Age group (years)	No of patients
1	0-20	2
3	20-40	15
4	40-60	7

b) Etiology (Tab 2) – There were mainly two etiology of these acquired defects in our study, trauma & its sequalae was the majority while , tumour and its excision were the other.

Tab 2: what caused the bony defect?

S No	Cause	No of patients
1	Trauma	17
2	Tumour	7

c) Bone graft recipients (Tab 3) – All the long bones of the hand were grafted in varying numbers. The metacarpals, larger among these were the most grafted while proximal and middle phalanxes were the next. There were 6 cases of strut bone graft where a bone was placed in a tubed flap as part of staged thumb reconstruction.

Tab 3: where was the bone graft placed?

S No	Recipient bone	Total
1	Metacarpal	9
2	Proximal Phalanx	4
3	Middle phalanx	4
4	Terminal phalanx	1
5	Bone graft for osteoplastic reconstruction	6

d) Source of the bone grafts (Tab 4) - As most of the grafts were mono cortical or corticocancellous, the bone grafts were harvested from subcutaneous part of proximal ulna or illac crest. Phalanges and metatarsals of foot were used when a bicortical graft was required. Hemihammate was harvested to reconstruct the articular surface of the middle phalanx to recover the joint movements.

Tab 4: From where the bone graft was harvested?

S No	Donor Bone	Total
1	Iliac Crest	5
2	Ulna	11
3	Phalanxes of foot	2
4	Hamate	3
5	Fibula	1
6	Metatarsal of foot	2

e) Forms of bone grafts (Tab 5) - The need of the bone for skeletal integrity decided the type of bone grafts. As most of the requirements were that of part of bone or strut bone grafts, these were met by unicortical or corticocancellous grafts. Only cancellous graft was used to fill a defect in terminal phalanx. Loss of entire bone were reconstructed by bicortical bone grafts (Segmental) .

Tab 5: Forms of Bone Grafts

S No	Nature of bone grafted	Total
1	Monocortical	7
2	Corticocancellous	8
3	Cancellous	1
4	Segmental	8

f) Survival of bone grafts (Tab 6) - All the bone grafts were assessed for the survival dimensions at end of 2 years by X-ray and compared in length, breadth and width of original graft dimension at time of placements. Although most of the graft survived there were resorbtion of two grafts placed in metacarpal defects. These were harvested from illac crest. Moreover, all strut grafts placed under a flap cover survived completely while the loss were seen under scarred , possibly less vascular skin cover.

Tab 6: Did the bone graft last 2 years?

S No	Forms of Bone Grafts	Maximum length	Survival (Resorbtion)- 2yrs
1	Monocortical	6 cm	100%
2	Corticocancellous	6 cm	75% (2 cases resorbtion)
3	Vascularized	8 cm	100%

1. (Free Fibular Vascularized Flap for metacarpal)

2. (Ulnar bone graft for proximal phalanx)

DISCUSSION
Grafting of smaller sized bony defects in hand pose a challenge to the hand surgeon. The aim of restoring form (structural integrity) as well as restoring or preserving function of the affected hand is paramount in these patients. The surgeon has to plan for nature of graft, donor graft properties, and approach to the defect and methods and time for immobilization.

While planning for the reconstruction of the bony defect, it is always important to consider the hand as one unit. Hence the etiology of the defect and the status of the remaining structures in hand are essential to regain the function. In our study, trauma was the leading etiology of such defects (71%) while tumor was other etiology (29%). Major trauma, presenting as larger defects (more than one bone) were addressed with vascularized bone grafts. In minor trauma and single bone defect, the non-vascularized bone grafts were placed. Primary reconstruction of the defect was done in all cases of tumour resection and smaller open fractures or bone loss. While the multiple bone reconstruction and complete loss of metacarpal was reconstructed by vascularized bone graft (8%), majority were smaller defects reconstructed by non-vascularized bone grafts.

All the long bones of hand were grafted in this study. The larger metacarpal bone amongst the longer bone was the most addressed bone (37.5%) while proximal and middle phalanxes were the next two (17%). In 25 % of patients, the bone graft was applied as strut graft in a tube flap for thumb loss as part of staged osteoplastic reconstruction.

The ulna was the bone from which most of the grafts were taken (46%) and the remaining were iliac crest (21%), Hammate (12.5%), Phalanges and Metatarsals of foot (17%), and one case of fibula graft. Traditionally illac crest graft has been favored for cortical or corticocancellous grafts but in our study we have used ulnar bone graft harvested from subcutaneous part of proximal ulna more often. Phalanges and hamate were used when part of articular surface or bicortical grafts were required. In one case of multiple metacarpal loss, free fibula was used to provide the structural integrity. The bone grafts can be used in different forms like monocortical, bicortical, or as cancellous graft. In our study, 29% of grafts were monocortical, 4% were cancellous, 8 % had articular surface while the remaining were corticocancellous (58%).

The survival of ulnar bone grafts exceeded those of illac crest bone grafts in our study. In terms of length and longevity of non-vascularized bone grafts Ulna bone grafts were superior to other monocortical grafts in this study. It also had the least donor site pain in postop and morbidity in late post-operative period.

CONCLUSION
The problem of grafting bone to hand requires a detailed plan of charting the actual requirement of facets of bone i.e. cortex or cancellous, length or width, with or without articular surfaces and an optimum donor bone surface.

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