Original Article

The Clinical Results of Benign Bone Tumor Treatment with Allograft or Autograft

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Abstract

Backgrounds: Curettage and bone grafting is a method which can eliminate benign bone tumors while restoring structural integrity, reducing the risk of pathological fractures. The aim of this research is to study the clinical outcomes of using allografts and autografts, in treating benign bone neoplasms.

Methods: A Historical Cohort was conducted on 119 patients with benign bone tumors treated with curettage and grafting from 2005 to 2011 in Shafa Yahyaiyan Hospital. The variables were age, gender, tumor type and location, staging, graft type, bone incorporation and recurrence. Data was analyzed with SPSS software, using descriptive statistics, tables, Fisher exact and LogRank tests. The significance level was chosen to be less than 0.05. The study was approved in Iran University of Medical Sciences.

Results: One hundred and nineteen patients, consisting of 63 treated with an allograft and 56 treated with an autograft were studied with a mean follow up of 37.5 months. 96.6% of the patients had complete incorporation of the graft into host bone after 6 months of surgery. There was no significant relationship between graft type and bone incorporation (P = 0.121). The estimated median time of recurrence was 20 months (SE= 6.55) in the allograft group and 9 months (SE= 0.77) in the autograft group using survival analysis. Using LogRank test, there was no significant difference between the median in the two methods (P = 0.288).

Conclusion: Autografts and allografts seem to yield similar success rates in the treatment of benign bone tumors. Although more detailed researches with higher sample sizes are recommended for future studies.

Keywords: Allograft, autograft, benign bone tumors

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Introduction

A primary bone tumor is a neoplastic growth of bone tissue which can be either benign or malignant. Primary bone tumors are a significant cause of morbidity and mortality, especially among the young. These tumors represent the sixth most common neoplasm in children, while in adolescents, they are the third most frequent, exceeded only by leukemias and lymphomas.[1,2]

Benign bone tumors range from static lesions, such as non-ossifying fibromas, to locally aggressive lesions, such as aneurysmal bone cysts. They are usually of no apparent cause, and have a very slow growth rate.[3,4] Benign bone tumors are often asymptomatic and discovered incidentally during evaluation for other conditions. When symptomatic, benign bone lesions may present with localized pain, swelling, deformity, or pathologic fractures. In most cases, the differential diagnosis of the lesions can be narrowed based on the age of the patient, the involved bone, the location of the lesion within the bone, the degree of pain and response to analgesics and basic physical examinations. 90% of benign bone tumors have characteristic radiographic features that can be diagnosed with plain radiographs.[5,6,7,8,9,10] Lesions under 5 cm can be treated by curettage alone. Larger lesions need to be filled with a graft due to the increased risk of pathological fractures.[11,12,13]

In addition, a group of pseudotumors masquerade as benign bone tumors. These lesions appear with greater frequency than primary bone tumors. Simple bone cysts are a common pseudotumor of the bone which typically affect patients between 5 and 15 years of age and occur more often in boys than girls.[14]

There are currently few types of bone graft available: Autograft, which is a bone obtained from one area of the same individual and transferred to the lesion. And Allograft, which is bone tissue transplanted from one individual to another.[13,15]

Other than natural bone grafting, the past century has seen significant advances in natural bone alternatives. A bone substitute can be defined as "a synthetic, inorganic or biologically organic combination which can be inserted for the treatment of a bone defect instead of autogenous or allogenous bone".[16] Examples of bone substitutes include: Hydroxyapatite [$Ca_{10}(PO_4)_6(OH)_2$] (HA) which is the crystalline form of tricalciumphosaphate (TCP) and the primary mineral component of teeth and bone; Calcium phosphate cements (CPC), which are synthetic bone substitutes in a white-colored powder, consisting of calcium phosphate, that when mixed with a liquid, form a workable paste which can be shaped during surgery to fit the bone loss; Calcium sulphate (CS); and Polymers, which have physical, mechanical, and chemical properties completely different from other bone substitutes and can be natural or synthetic, bone collagen being one of the most important natural polymers.[17,18,19] A level II and a level IV study found lesser pain, operating time, blood loss and complication in synthetic substitutes compared with iliac crest grafts.[20]

The advantages of autograft are well established. It is usually

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well incorporated in benign lesions and is non-immunogenic. But it is of limited resource, especially in children where the size of the lesion may exceed the available supply of autograft. Also, the acquisition of an autograft requires an additional incision, which leads to increased postoperative morbidity.[9,21] Donor site complications such as infection and lateral femoral cutaneous nerve injury, as well as structural insufficiency that can lead to fracture and may result in increased patient recovery time, disability, and chronic pain.[15,22] Although autogenous bone graft is still considered to be the gold standard for bone grafting, the problems noted have led to an ongoing research to find suitable bone substitutes.[23,24]

Allograft, on the other hand, has the advantage of an unlimited supply. It is available in any size and shape to fit an individual situation. Also, there is no additional donor site morbidity or increased operative time associated with its use. The disadvantages of allograft include its immunogenic potential, relatively slow incorporation and the potential for disease transmission.[10,25]

In a study conducted by Valdespino Gomez VM, et al., in 1990, 1,200 patients were reviewed 81% of whom had benign bone tumors, the most frequent being osteochondroma, enchondroma and giant cell tumor[8]. In another study from 1997 to 2008 by Solooki, et al. in Shiraz, Iran on 426 patients, the most frequent benign tumors found were also the same.[26]

In another study conducted in 1991 in Colorado, US, 54 children with benign bone lesions treated with grafts were reviewed based on time of bone incorporation depending on the size of the lesions. There was no difference between the success rates of allograft and autograft in lesions under 60 cc. But in bigger lesions, there was 38% complete and 19% incomplete incorporations in the allograft group, while all patients treated with an autograft, had either complete (69%) or incomplete (31%) incorporation.[13]

The use of allografts has been accompanied by different clinical results in recent years. Also, since there are only a few studies regarding the use of autografts, especially when compared to the use of allografts in the treatment of benign bone tumors in adult population, there is still doubt on its rate of effectiveness.[6,27] The objective of this study is to review clinical experiences of using an autograft or allograft for treating benign bone tumors, in order to investigate the success rates of each method.

Materials and Methods

In this historical cohort study, the target population was patients with benign bone tumors treated with curettage and grafting with an autograft or allograft from 2005 to 2011 in Shafa Yahyaiyan Hospital, Tehran. The sample sizes in autograft and allograft groups were 56 and 63 patients, respectively which were collected from patients with confirmed benign bone tumors via pathology reports. The inclusion criterion was having a benign bone tumor from 2005 to 2011 and the exclusion criteria were incomplete data, no pathology report or less than 12 months of follow up.

In the baseline of the study, both autograft and allograft groups were checked according to age, gender, and tumor type in order to determine the comparability of the two groups.

The data were collected using a checklist which included age, gender, tumor type, tumor staging, tumor location, graft type, bone incorporation and recurrence.

In pre-operation radiographies, tumor locations (long bones, short bones, wide bones), and tumors staging (Benign latent, Benign active, Benign aggressive) were reviewed and in post-operation radiographies the autograft or allograft bone incorporation and tumor recurrence were reviewed. If after six months of operation, incorporation was observed in the radiography results, the lesion would be considered as incorporated; otherwise, the patient would be listed as without any incorporation. If the patients had complete incorporation without any recurrence in the follow up period, we defined the treatment as successful.

The data was analyzed using SPSS software and descriptive statistics (tables, graphs, and numerical statistics), fisher exact test and LogRank test were used for analysis. The significance level was chosen to be less than 0.05. The treated patients' data was kept confident and the research was approved in the school of medicine, Iran University of Medical Sciences.

Results

The participants were 55 females (46.2%) and 64 males (53.8%) with a mean age of 21.6 years (SD = 12.27 year) and the minimum and maximum ages of 3 and 70 years, respectively. Among the participants, 63 (53.9%) were treated using an allograft and 56 (47.1%) with an autograft. The distribution of some patients' characteristics in both study groups are shown in Table 1. There was no significant relationship between the mean age between allograft and autograft groups (22.9 year in allograft and 20.2 in autograft; $P = 0.229$). Also, there was no significant relationship between the groups and gender ($P = 0.681$), or groups and tumor type ($P = 0.18$).

Among the patients, 115 had bone incorporation and 4 were without bone incorporation. In patients with bone incorporation, 59 were (5 with and 54 without recurrence) treated with an allograft and 56 (10 with and 46 without recurrence) with an autograft. All four patients who were without bone incorporation, had been treated with an allograft. Two were with and two were without any local recurrences.

According to Fisher's exact test, there was no relationship between graft type and bone incorporation ($P = 0.121$). The data for patients with no bone incorporation are shown in Table 2.

Seventeen patients in this study (14.3%) had a recurrence during follow up, and 102 (85/7%) did not. The patients with a recurrence were 7 in the allograft group with the mean recurrence time of 20.7 months (SD = 10.66). In the autograft group, 10 patients had a recurrence with the mean recurrence time of 12.9 months (SD = 11.59). Also, the results shows that with increasing follow up time, the frequency of recurrence increased as well and while there were only two recurrences within the first 20 months of follow up, there were 6 recurrences after the fifth year of follow up. Also, survival analysis was used to review the estimation of the time of recurrence. The estimated median time of recurrence was 20 months (SE = 6.55) in the allograft group and 9 months (SE = 0.77) in the autograft group (Figure 1). Using LogRank test, there was no significant difference between the median in the two methods ($P = 0.288$). The data for patients with recurrence are summarized in Table 3.

Discussion

Fifty two point nine percent (52.9%) of the patients in the study were treated with an allograft and 47.1% with an autograft. It seems that there is not much difference in choosing graft types and the slightly higher number of allografts is related to the lim-

Table 1. Distribution of some patients' characteristics in both study groups.

Characteristics of groups	Gender		Tumor Location		
	Male	Female	Long Bones	Short Bones	Wide Bones
Allograft	35 (54.7%)	28 (50.9%)	45 (58.44%)	5 (23.81%)	13 (81.25%)
Autograft	29 (45.31%)	27 (49.1%)	32 (41.56%)	21 (76.19%)	3 (18.75%)
Total	**64 (100%)**	**55 (100%)**	**77 (100%)**	**26 (100%)**	**16 (100%)**
Characteristics of groups	**Biopsy**			**Stage**	
	Bone Cysts	**Fibrotic Tumors**	**Others**	**Benign Latent**	**Benign Active**	**Benign Aggressive**
Allograft	24 (53.34%)	15 (41.67%)	24 (63.15%)	34 (55.73%)	28 (49.12%)	1 (100%)
Autograft	21 (46.66%)	21 (58.33%)	14 (36.84%)	27 (44.26%)	29 (50.88%)	0
Total	**45 (100%)**	**36 (100%)**	**38 (100%)**	**61 (100%)**	**57 (100%)**	**1 (100%)**

Table 2. The data for patients without bone incorporation.

Age	Gender	Graft Type	Place of Tumor	Type of tumor	Staging	Recurrence
26	Male	Allograft	Long bone	Benign Fibrotic tumor	Benign latent	No
18	Male	Allograft	Long bone	Bone cyst	Benign active	Yes
47	Female	Allograft	Short bone	Other (enchondroma)	Benign active	Yes
16	Male	Allograft	Long bone	Bone cyst	Benign latent	No

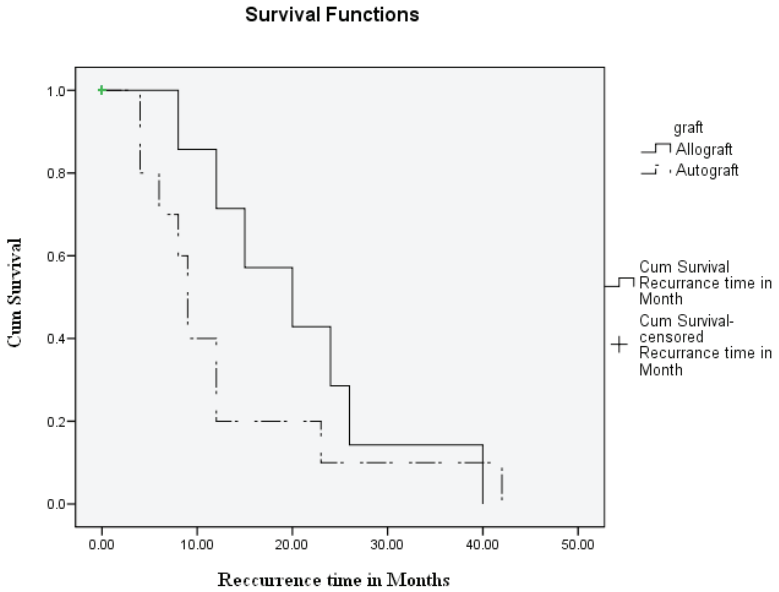

Figure 1. The survival function for the period of recurrence in Autograft and Allograft methods.

ited supply of autografts. The number of allografts used is also slightly higher in the study of Glancy, et al., and Asavamongkolkul, et al., which is similar to our study and different from the studies of Basarir, et al., and Yercan, et al.[13,28,29] This difference is probably due to the specific location and tumor types of these two studies which has made using autografts easier and more efficient. Also, the patients in this study consisted of 46.2% women and 53.8% men. The slight dominance of the male population is probably due to the higher prevalence of benign bone tumors among males.[31] These results are similar to those of Basarir, et al., Asavamongkolkul, et al., and Yercan, et al., and different compared to the study of Jamshidi, et al.[29,28,30]

Forty six percent of the patients were between 10 to 19 years of age and patients above 40 years of age had the least frequency. The mean age of the patients was 21.6 years. This is mostly due to the characteristics of benign bone tumors which are usually diagnosed in children and young adults. These results are similar to those of Glancy, et al., Basarir, et al., and Jamshidi, et al., and different compared to those of Asavamongkolkul, et al., and Jamshidi, et al.[13,29,33,28] This difference is probably because of the specific tumor types and tumor locations studied in the mentioned researches.

The mean and median follow up period of this study was 37.5 and 32 months, respectively and with the maximum follow up

Table 3. The data for patients with recurrence.

Age	Gender	Graft	Location	Type of tumor	Staging	Rec.	Rec. time
18	Male	Allograft	Long bone	Bone cysts (ABC)	Benign active	No	12
10	Female	Allograft	Wide bone	Benign Fibrotic tumors	Benign active	Yes	40
47	Female	Allograft	Short bone	Others (Enchondroma)	Benign active	No	15
14	Female	Allograft	Wide bones	Bone cysts (ABC)	Benign active	Yes	24
15	Female	Allograft	Long bones	Others (Chondroblastoma)	Benign active	Yes	26
34	Male	Allograft	Wide bones	Bone Cysts	Benign active	Yes	20
25	Female	Allograft	Long bones	Others (Osteoid Osteoma)	Benign active	Yes	8
14	Female	Autograft	Long bones	Bone cysts	Benign active	Yes	4
13	Female	Autograft	Long bones	Bone cysts	Benign active	Yes	8
21	Male	Autograft	Long bones	Bone cysts	Benign active	Yes	4
26	Female	Autograft	Long bones	Bone cysts	Benign active	Yes	9
25	Female	Autograft	Long bones	Benign Fibrotic tumor	Benign active	Yes	9
30	Female	Autograft	Long bones	Benign Fibrotic tumor	Benign latent	Yes	12
24	Female	Autograft	Short Bones	Bone cysts (ABC)	Benign active	Yes	23
7	Male	Autograft	Long bones	Bone cysts (ABC)	Benign active	Yes	6
15	Female	Autograft	Long bones	Others (Chondroblastoma)	Benign active	Yes	42
70	Female	Autograft	Short bones	Others (Enchondroma)	Benign active	Yes	12

Rec = recurrence.

time being 85 months, the minimum was 12. Due to the high recurrence rate of benign bone tumors (20 – 40% in some studies) and also due to the slight low risk of malignancy transformation, a long follow up period is needed and the higher the follow up period, the higher the rate of diagnosing recurrence.[34,35,36] Nevertheless, based on the study of Parker, et al., most recurrences occur during the first two years of follow up.[36] The mean follow up period in this study was similar to the studies of Basarir, et al., and Jamshidi, et al. while being longer than the studies of Borjian, et al., and Jamshidi, et al. was shorter than that of Shih, et al., Asavamongolkul, et al., and Yercan, et al.[29,33,37,32,38,28] It is necessary to mention that the follow up period of patients with an autograft in this study was noticeably higher than that of the allograft patients and over 50% of the autograft patients had a follow up of longer than 60 months. This was mostly because of the higher rate of using autografts in the beginning years of this study (2005–2006) in ShafaYahyaian hospital compared to allografts, which lead to a longer follow up period in the treated patients.

115 (96.6%) of the patients had achieved union in the host bone after 6 months of initial surgery and only 4 patients (3.4%), all of whom were treated with a allograft, had not achieved complete incorporation of the graft into host bone until this time. There was no significant relationship between bone incorporation and the graft type ($P = 0.121$). These results were comparable to those of Basarir, et al., with $P > 0.005$, Asavamongkolkul, et al., with 80% success of incorporation into host bone on patients treated with an allograft and 100% in the ones with an autograft, and Yercan, et al., with 93.3% incorporation the Allograft group and 96.7% in the autografts.[29,28,30] Also, although the results of this study are similar to that of Glancy, et al., in lesions under 60 cc (90% in the allograft group and 100% in the autografts), there is a noticeable difference between these results in lesions above 60 cc which cannot be analyzed due to the fact that the lesions in this study were not stratified by size.[13]

Seventeen (17) patients in this study (14.3%) suffered a recurrence during their follow up period (7 patients with an allograft and 10 with an autograft) and 85.7% had no signs of recurrence. These results are different compared to those of Basarir, et al., Shih, et al., Li, et al., Asavamongkolkul, et al., Yercan, et al.,and Jamshidi, et al., with 1.7%, 0, 6.7%, 6.6%, 3.9%, 0 recurrence rates, respectively and similar to those of Jamshidi, et al., and Borjian, et al.[29,38,39,28,30,33,32] This could be due to the fact that these two studies were also conducted in Iran. Although the number of recurrences is slightly higher in the autograft group, the reason could be the longer follow up time in the patients which has led to the detection of more recurrences in them. According to the statistical analysis, there was no significant difference between the median time of recurrence in the two methods ($P = 0.288$) and the mean time for recurrence being 20.7 months for patients in the allograft group, was 12.9 for patients treated with an autograft. These results are similar to that of Parker, et al., who mentioned that most tumor recurrences occur in the first two years of follow up.[36]

In conclusion, autografts and allografts seem to yield similar success rates in the treatment of benign bone tumors. Therefore, based on the results of this study, allografts can be safely used as an alternative to autografts when only a limited supply is available.

Since the clinical records of patients were used, mistakes in data collection are possible. Also, the follow up period was different for and while some had a relatively long follow up, the others had a short period of follow up. Furthermore, due to the limitation of autograft cases, most of autograft cases were related to some special anatomic points such as the phalanxes.

It is suggested that a longitudinal study should be performed with a longer follow up period in the future in order to better compare the result of the two methods. Also, we suggest studies to be

done for each different area and each of the many types of benign bone tumors. Finally, with a suitable study designed on cases of benign bone tumors with recurrence or without bone incorporation, it is possible to find and evaluate the effective factors on these outcomes more precisely.

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