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## Limb Salvage with Low Heat Treated Autobone in Malignant Bone and Soft tissue Tumor

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**Purpose:** Through retrospective analysis of malignant tumor patients limb-salvaged by low-heat treated autobone, effectiveness of the pasteurized autobone was evaluated.

**Materials and Methods:** Twenty-seven patients who underwent limb salvage operation using low-heat treated autobone between 1994 and 2001, and followed up for minimum of 12 months

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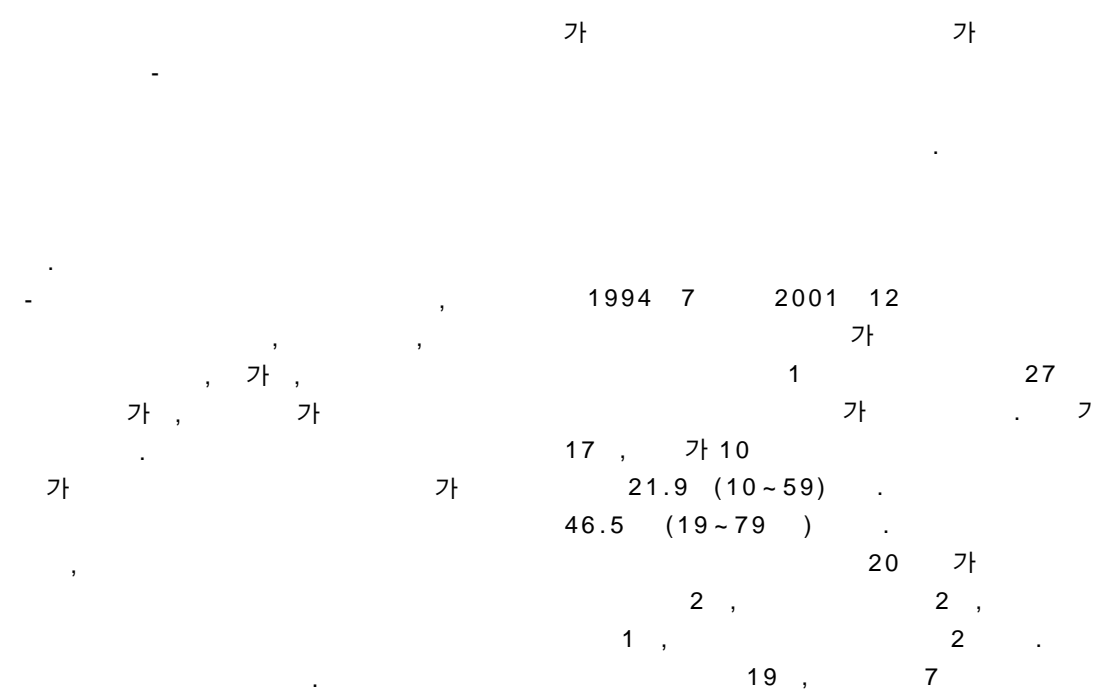
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were included in this study. The mean age at surgery was 21.9 years (range, 10-59), and the mean follow-up was 46.5 months (range, 19-79). Radiological evaluation of the proximal and distal potential union sites was carried out.

**Results:** In all cases, low-heat treated autobone grafting along with fixation by appropriate methods were performed. The overall union rate of the low-heat treated autobone with normal host bone was 77.4%, and the mean union time was 5.0 months(range, 3-8 months) after surgery. Single osteotomy site comprised 17 cases while double osteotomy sites comprised 7 cases. Among the single osteotomy cases, union rate of ten femur cases was 100%, and mean union time was 4.8 months. All seven distal humerus cases showed 100% union rate at mean union time of 5.6 months. Double osteotomy cases were all of the femur and 2 proximal(29%) and 5 distal(71%) sites showed union at an average of 6 months and 5.0 months. Complications included nonunion in five patients(18.5%), fracture in three patients(11.1%), shortening in one patient, resorption in one patient, and valgus deformity in one patient. The overall mean survival was 68 months, and 5-year survival rate was 66% based on a Kaplan-Meier survival analysis.

**Conclusion:** Limb salvage with Low-heat treated autobone graft might be an effective treatment option for primary bone sarcoma and could replace limb salvage with allograft bone.

**Key Words:** Low-heat treated autobone, Union



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가 4 ,  
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가 1 ,  
가 1 ,  
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ender-nail  
thesis plate  
가 1 , Neer pros-  
가 6 , cement  
IM nail

. 23

Bard mesh

3  
3  
Enneking stage  
IIB가 20 가  
2  
1

. 23  
Arthrodesis  
ender-nail  
2  
2

IIA가 3 , III가  
IIA가 1 , IIB가

Bipolar hemiarthroplasty  
ender-nail  
Arthrodesis . 7  
Intercalary , double plate  
가 4 , IM  
3 cm , nail plate 가 3

65,C 30  
가  
가

shape 가  
22.0 cm(11~52)  
19 (73%)

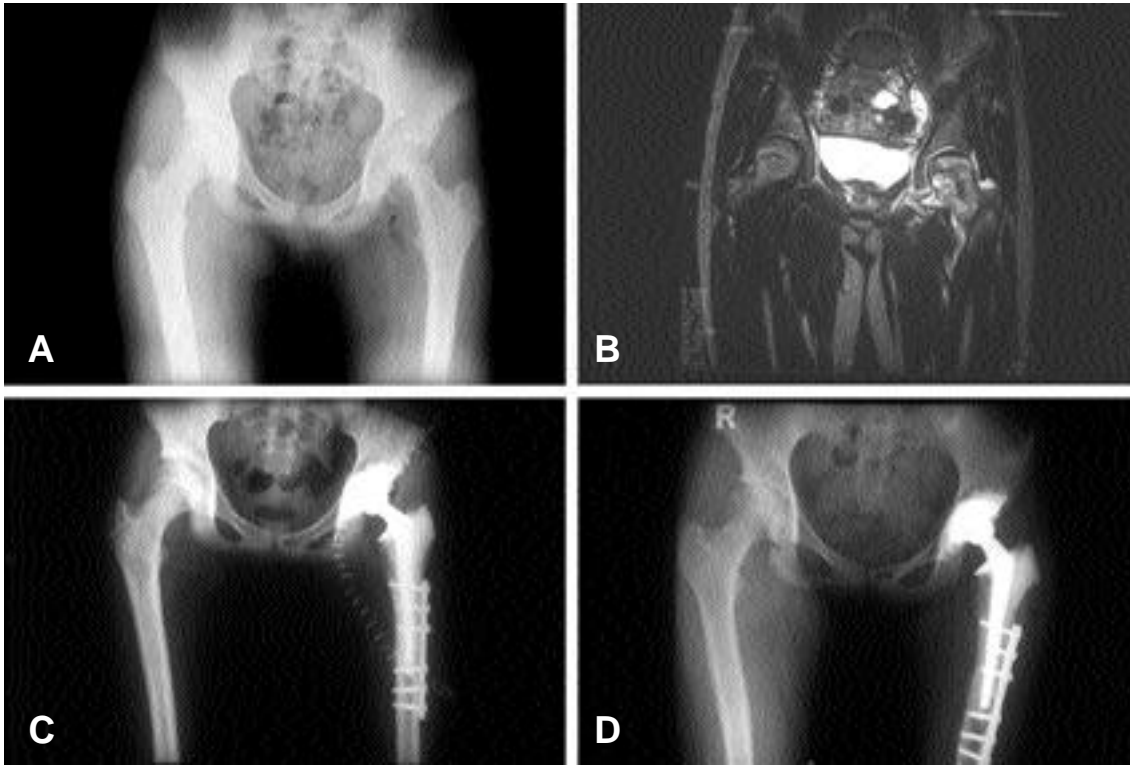
Arthroplasty  
가 16 , Arthrodesis 가 2 ,  
Arthroplasty Arthrodesis  
가 2 , Intercalary 가 7 가  
. Arthroplasty 가

1  
THA plate  
가 3 , bipolar hemiarthroplasty  
plate 가 2 , long stem  
bipolar hemiarthroplasty 가 3  
, bipolar hemiarthroplasty

1. 27 6 2  
 3 24 31  
 가 가 가 17 ,  
 가 7 .(Table 1), 가  
 가 2 , 1 가  
 가 8 , 가 7 1  
 7 가  
 17 100.0% 7  
 2 5.5  
 , 8 4.1 3.  
 (3~8) 7  
 5.6 (3~7) 4.9 23 (77.7%)  
 가 7 , 99% 8 , 90~98%  
 2 (29%) , 5 (72%) 가 4 , 90% 11  
 50% , 11  
 6 , 5.0  
 5.3 가 1  
 12 24 ( 90% ) 12  
 (77.4%) 5 가 ,  
 5.0 ( 90% ) 11 5  
 70.8% ,  
 100% .

Kaplan-Meier survival analysis

2. 68 5-year survival  
 rate 66% .  
 5  
 11 (40.7%) ,  
 5 (18.5%), 3 ( 가  
 1 ), 1 ,  
 1 , 1 (Table.1).  
 3 ,  
 1 , 1 .  
 MRI  
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 (Fig. 2). 1  
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**Fig. 1.** A 16-year-old girl had osteoblastic osteosarcoma of the proximal femur. **A.** A preoperative plain radiograph shows a radiolucent lesion on the femoral head and neck. **B.** T1-weighted coronal magnetic resonance image shows low signal intensity of femoral neck. **C.** A postoperative radiograph shows the reconstruction of the hip with bipolar hemiarthroplasty and the osteotomy site **D.** A plain radiograph obtained at the 24-month follow up shows a solid bony union.

Toni <sup>23)</sup>

가 , Cobb <sup>2)</sup>  
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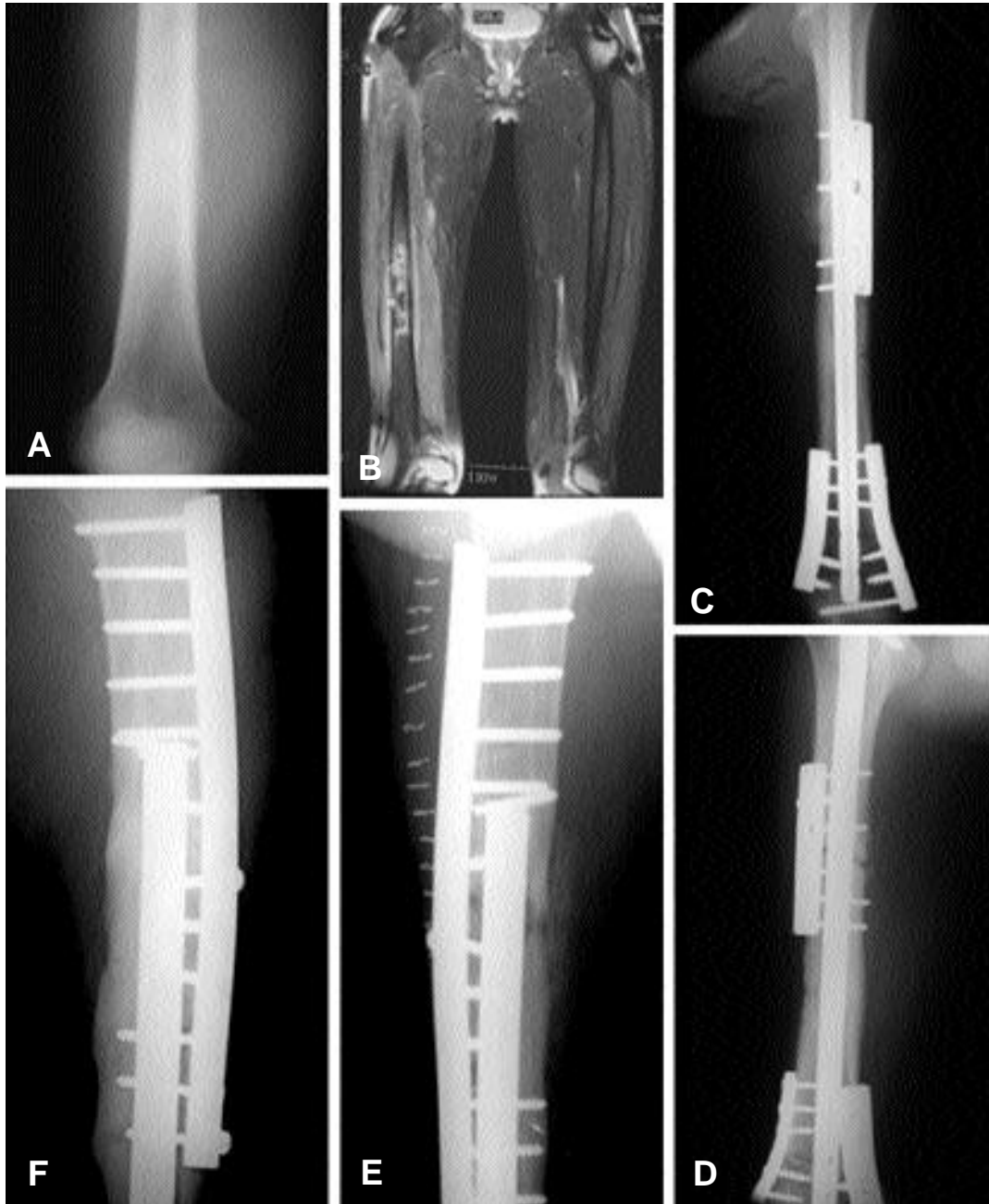
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**Fig. 2A-F.** A 19-year-old boy had osteoblastic osteosarcoma on the shaft of femur. **A.** A preoperative plain radiograph shows a radiolucent lesion on the femoral diaphysis. **B.** T2-weighted coronal magnetic resonance image shows invasion of femur by a tumor mass. **C.** A postoperative radiograph shows the reconstruction of the femur with IM nail & plate, two osteotomy sites. **D.** A plain radiograph obtained at the 2-year follow up shows a nonunion with metal failure of proximal femur. **E.** A postoperative radiograph shows the revision with nail removal and bone graft. **F.** A plain radiograph obtained at the 7-month follow up after revision shows a solid bony union.

**Table 1.** Summary of cases

Case No	Age/ Sex	Diagnosis	Stage	Location	Operation	Resection Length (cm)	Re-used Length (cm)	Union site	Time to Union (mos)	Follow up (mos)	Complication
1	M/11	OS	IIb	Distal femur	P: cannulated screws, D: Plate & screws	28	28	2	P, X, D: 3	16	Nonunion
2	M/33	OS	IIb	Humerus	Neer prosthesis, Plate & Screws	18	16	1	D: 6	54	
3	M/21	OS	IIb	Distal femur	DCS plate & screws	13	13	2	P, X, D: X	38	Nonunion
4	F/38	FS	IIb	Distal femur	Plate & screws	11	11	1	D: 8	53	Shortening
5	M/33	OS	IIb	Prox. Femur	Bipolar hemiarthroplasty	19	16	1	D: 3	12	
6	F/22	OS	IIb	Humerus	Neer prosthesis, Plate & screws	12	10	1	D: 6	35	Resorption & Fracture
7	M/14	OS	IIb	Prox. Femur	THA	26	10	1	D: 7	17	
8	M/14	OS	IIb	Humerus	Neer prosthesis, plate & screws	17	14	1	D: 4	50	Fracture
9	M/11	OS	III	Prox. Femur	Bipolar hemiarthroplasty, Endemail, cementation	18	6	1	D: 5	15	
10	M/12	ES	IIb	Distal femur	P: Plate & screws, D: DCS plate & screws	19	19	2	P, 6, D: 6	15	Valgus deformity
11	M/37	RS	IIb	Femur	IM nail, P: Plate & screws, D: Plate & screws	16	16	2	P, X, D: 4	44	Nonunion
12	F/62	OM	Ila	Prox. Femur	Bipolar hemiarthroplasty, Plate & screws	16	14	1	D: 4	23	
13	F/11	OS	IIb	Distal femur	P: Plate & screws, D: Endemail, cementation	31	20	1	D: 3	12	
14	M/20	OS	IIb	Prox. Femur	THA, Plate & screws	18	15	1	D: 4	24	
15	M/24	OS	IIb	Distal femur	IM nail, P: Plate & screws, D: Plate & screws	46	46	2	P, 6, D: 6	37	Metal failure
16	M/16	OS	IIb	Distal femur	IM nail, P: Plate & screws, D: Plate & screws	26	26	2	P, X, D: X	20	Nonunion
17	M/57	CS	Ila	Humerus	Neer prosthesis, Plate & screws	15	15	1	D: 6	56	
18	F/30	OS	IIb	Humerus	Neer prosthesis, Plate & screws	19	19	1	D: 3	56	
19	M/11	OS	IIb	Humerus	IM nail, bone cementation	17	8	1	D: 7	13	
20	F/29	CS	IIb	Pelvis	THA, reconstruction plate, cementation	*	*	*	*	16	
21	M/23	OS	IIb	Femur	IM nail, P: Plate & screws, D: Double plate	22	22	2	P, X, D: 6	49	Nonunion
22	F/26	OS	IIb	Humerus	Neer prosthesis, Plate & screws	16	16	1	D: 7	47	
23	M/41	OM	Ila	Prox. Femur	Bipolar hemiarthroplasty	20	16	1	D: 4	loss(4)	
24	M/18	OS	IIb	Prox. Femur	Bipolar hemiarthroplasty, Ender nail & cementation	52	28	*	*1	2	
25	F/19	OS	IIb	Prox. Femur	THA, Plate & screws	14	12	1	D: 3	48	
26	F/21	OS	IIb	Prox. Femur	THA, Plate & screws	18	14	1	D: 3	36	Fracture
27	F/14	OS	III	Distal femur	THA, Ender nail, cementation	45	30	*	*	12	

Os: Osteosarcoma; CS: Chondrosarcoma; RS: Rhabdomyosarcoma; ES: Ewing's Sarcoma; OM: Oncogenic Osteomalacia; IM nail: Intramedullary nail; THA: Total Hip Arthroplasty; DCS: Dynamic Condylar Screw

**Table 2.** Summary of surgical technique

Surgical Technique	cases	49	38 (77.5%)	7
Arthroplasty(AP)	THA	3	21 (55%)	
	bipolar hemiarthroplasty	6		
	Neer prosthesis	6		4.9
	cementation + IM nail	1	24 (77.4%)	31
Arthrodesis(AD)		2	11 (40.7%)	
AP + AD		2		
Intercalary	Plate & screws	4	23 (85.1%)	
	IM nail + plate	3		27.6%

(8/29 )

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Kotoura <sup>10)</sup> 가

5000 cGY 1 9 <sup>11)</sup> 80%

1 6.5

Lu <sup>13)</sup> 가

50℃ 15

Thompson Steggal <sup>22)</sup> 가

131℃ 5

70 가

1 131 2 Kohler <sup>9)</sup> 가 Ender 9

9%가 Kirk Johnstoff 27 3 (11.1%) 7.5

가

Freidlaender <sup>4)</sup> 가

Liebergall

<sup>12)</sup> 60 30 12.6 cm

Ham <sup>6)</sup> 65 가 <sup>17)</sup>

Manabe <sup>5)</sup> 2 가 , 3

Aho . 1

<sup>1)</sup> 3 ~ 4 <sup>7)</sup>



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