

## CLINICAL STUDY

# Our experience with chemosterilized antigen-extracted autolyzed allografts (AAA) in a series of elective foot and ankle procedures

Almasi J<sup>1</sup>, Csonge L<sup>2</sup>, Galambos B<sup>2</sup>

*Petz Aladar County Teaching Hospital Gyor, Traumatology, Orthopaedics and Hand Surgery Centre, Gyor, Hungary. [almasijozef@yahoo.com](mailto:almasijozef@yahoo.com)*

**Abstract:** *Background:* It is generally accepted that the golden standard for bone grafting is the autogenous bone.

*Objectives:* The purpose of our retrospective study was to review and show a single-surgeon experience with chemosterilized antigen-extracted autolyzed (AAA) bone allograft in foot and ankle procedures.

*Methods:* The study population consisted of 35 patients who were operated on between January 2005 and January 2009. All patients were eligible for inclusion in this study if their surgery was performed using the chemosterilized antigen-extracted autolyzed allogeneic bone (AAA). In this study, the authors wanted to emphasize the effectiveness of AAA bone grafts in reconstructive foot surgery. All allografts were harvested, prepared and obtained from West Hungarian Regional Tissue Bank Győr.

*Results:* Union was defined both clinically and radiographically and was established on subjective and objective criteria. A total of 35 consecutive foot and ankle implant procedures were performed, there were 32 healed sites (91.43 %) 2 nonunion (5.71 %) and 1 deep infection complication (2.86 %).

*Conclusion:* The authors have shown that AAA allograft is appropriate for reconstructive procedures of the foot and ankle with a low rate of complication (*Tab. 1, Fig. 2, Ref. 8*). Full Text (Free, PDF) [www.bmj.sk](http://www.bmj.sk).

**Key words:** bone grafts, allograft, osteoinduction, arthrodesis.

Bone is the second most frequently transplanted tissue. It is estimated that more than 1.3 million bone grafting procedures are performed in the United States annually (1). It is generally accepted that the gold standard for bone grafting is autogenous bone but improved allogeneic bone preparation, advances in surgical technique, and a better understanding of bone biology and biomechanics have made the use of allogeneic bone graft more feasible for the foot and ankle surgeons. The complications related to obtaining autogenous grafts can be significant and numerous materials are now available for substitution. In 1965 Marshall Urist first described the osteoinductive potential of demineralized bone after intramuscular implantation in animal experiments (2, 3). The purpose of our retrospective study was to review and show a single-surgeon experience with chemosterilized antigen-extracted autolyzed (AAA) bone allograft in foot and ankle procedures. Bone grafting has been used to treat conditions including, the treatment of osseous defects from trauma, infection, and tumors, to augment arthrodeses, to provide lengthening or angulation correction, and to induce delayed union and nonunion (4, 5).

## Methods

The study population consisted of 35 patients who were operated on between January 2005 and January 2009. All patients were eligible for inclusion in this study if their surgery was performed using the chemosterilized antigen-extracted autolyzed allogeneic bone. Allograft incorporation in all surgical procedures was retrospectively analyzed using the medical chart and radiographic analysis was performed. All procedures were done by one surgeon, author J.A. All allografts were harvested, prepared and obtained from West Hungarian Regional Tissue Bank Győr. Union was defined both clinically and radiographically and was established on subjective and objective criteria. Subjective criteria included no pain, warmth and swelling at the surgical site and full weight bearing. Objective criteria included stability during a forced manipulation across the surgical site and radiographic cross trabeculation at the graft-host interface on at least 2 radiographic views.

## Results

A total of 35 patients, 35 feet undergoing various elective surgical procedures were performed (Tab. 1). All arthrodesis, lengthening and angulation correction were stabilized with internal fixation (Figs 1 and 2). There were 21 women and 14 men. The average age was 41 years (range, 15–73). Clinically and radiographically there were 32 healed sites (91.43 %). The aver-

<sup>1</sup>Petz Aladar County Teaching Hospital Gyor, Traumatology, Orthopaedics and Hand Surgery Centre, Gyor, Hungary, and <sup>2</sup>West Hungarian Regional Tissue Bank Győr, Hungary

**Address for correspondence:** J. Almasi, MD, Jasna 274, SK-929 01 Vélke Dvorníky, Slovakia.  
Phone: +421.905.825305

**Tab. 1. Performed elective foot and ankle surgical procedures.**

Procedure	No of pts	Healed sites	Additional
Subtalar arthrodesis	3	3	–
Triple arthrodesis	7	5	2 nonunion
Tibiocalcaneal arthrodesis	1	1	–
Calcaneocuboid arthrodesis	2	2	–
Opening calcaneal osteotomy	4	4	–
Navicularcuneiform arthrodesis	2	2	–
Tarsometatarsal arthrodesis	3	3	–
Metatarsophalangeal arthrodesis	4	4	–
Filling the cysts and defects	7	6	1 deepinfection
Delayed union andnonunion	2	2	–
<b>Total</b>	<b>35</b>	<b>32 (91.43%)</b>	

age time for radiographic and clinical healing was 13 weeks (range, 8–36 weeks). There were 2 nonunions (5.71 %), both were the talonavicular component of triple arthrodesis and 1 deep infection complication (2.86 %).

**Discussion**

The ideal bone grafting material will exhibit the 3 physiologic properties of osteogenesis, osteoinduction and osteoconduction. Although autogenic bone graft remains the golden standard, it is not without inherent risk or complications. Summers and Einstein reported on 290 patients who underwent iliac crest bone-graft harvesting. Twenty-five percent continued to have pain at the donor site 4 to 6 years postoperatively (6). Michelson and Curl reported an increased surgical time, significantly greater blood loss, and higher overall costs for patients undergoing iliac crest bone harvesting (7). Analysis of



**Fig. 1. A 55-year-old woman with subtalar and Chopart joint arthritis after calcaneal fracture.**



**Fig. 2. Correction of the malalignment and fusion with triple arthrodesis. Evidence of radiographic healing after 12 weeks.**

donor-site morbidity also includes stress fracture, nerve damage, cosmetic disability, infections, the requirement of general as opposed to regional anesthesia, greater postoperative pain, limited graft supply, and longer hospital stays (6). In addition to the obvious differences between allograft and autograft, there is a relatively unlimited supply of allogeneic material. Lyophilized and sterilized human AAA bone can be stored at room temperature in container for several years without losing its properties. AAA bone is also safer with regard to the transmission of infectious diseases, including HIV, because its preparation destroys microorganisms within the bone matrix. The process of bone demineralisation reduces the probability of human immunodeficiency virus survival to less than 1 in 2.8 billion (1). Other potential problem is that allogeneic bone has been shown to decrease fatigue strength in compression by 10 % to 29 %, to decrease tension strength by 55 % to 90 %, and resistance to torsion moments by 40 % (8). The chemosterilized antigen-extracted autolyzed allogeneic bone due to almost perfect removal of cellular elements, desantigenisation in more stages, and parallel sterilisation preserved inductive morphogens and cofactors necessary for the transformation of migratory mesenchymal cells into chondroblasts and osteoblasts (3). In those reconstructive procedures necessitating bone graft, chemosterilized antigen-extracted autolyzed allograft should be considered an attractive alternative in reconstructive surgery of the foot and ankle, and avoids the potential for complications associated with harvesting autograft, reduces operative time and cost and can fill large voids that cannot be filled with autograft. Shortcomings of this study include a relatively small sample size and the fact that multiple surgical procedures were performed, but the authors have shown that AAA allograft is appropriate for reconstructive procedures of the foot and ankle with a low rate of complication.

## References

1. **Weinraub GM, Cheung C.** Efficacy of allogenic bone implants in a series of consecutive elective foot procedures. *J Foot Ankle Surg* 2003; 42 (2): 86—79.
2. **Urist MR, Silverman BF, Buring K, Dubuc FL, Rosenberg JM.** The bone induction principle. *Clin Orthop* 1967; 53: 243—283.
3. **Csönge L.** A csont és egyéb kollagén alapú szövetek immunológiája. *Orvosi hetilap* 1994; 25: 1347—1353.
4. **Catanzariti A, Karlock L.** The application of allograft bone in foot and ankle surgery. *J Foot Ankle Surg* 1996; 35 (5): 440—451.
5. **Thordarson DB, Kuehn S.** Use of demineralized bone matrix in ankle/hindfoot fusion. *Foot Ankle Int* 2003; 24 (7): 557—560.
6. **McGarvey WC, Braly WG.** Bone graft in hindfoot arthrodesis: allograft vs autograft. *Orthopedics* 1996; 19: 389—394.
7. **Michelson JD, Curl LA.** Use of demineralized bone matrix in hindfoot arthrodesis. *Clin Orthop* 1996; 325: 203—208.
8. **Pelker RR, Freidlaender FJ.** Biomechanical aspects of bone autografts and allografts. *Orthop Clin North Am* 1987; 18: 235—239.

Received April 23, 2009.  
Accepted January 17, 2010.