

Two-Stage Revision ACL Reconstruction: Supercritical Sterilized Bone Allograft is Effective in the Treatment of Tunnel Defects.

Gerrit J Van de Pol, MD, FRACS
 Sjoerd Ruen, MD, PhD
 Lucy J Salmon, PhD
 Fiona Bonar, MBBCh, FRCPA
 Justin P Roe, MBBS, FRACS
 Leo A Pinczewski, MBBS, FRACS

INTRODUCTION

The aim of this study was to examine the histological properties of the grafted bone tunnels at the time of second stage revision ACL reconstruction to assess the in-vivo appearance of supercritical carbon dioxide sterilized bone allograft and to quantify the amount of graft incorporation. Additionally, we intended to compare the histological incorporation to its radiological appearance and correlate the incorporation to the clinical outcome of the revision procedure. This is the first study describing the use of supercritical sterilized bone allograft in humans.

METHODS:

Histology and histomorphometric analysis as done on 12 subjects who underwent two-stage revision ACL reconstruction. In the first stage, the femoral and tibial tunnels were grafted with SCCO2 sterilized bone allograft. In the second stage, the revision ACL reconstruction was performed and bone biopsy specimens were taken.

RESULTS:

Twenty patients had core biopsies taken at the time of their second stage revision ACL procedure. Due to sampling inadequacies, poor biopsy quality or core sample fragmentation, eight biopsy specimens were not suitable for detailed histomorphometry and incorporation measurements. The remaining twelve patients all had uneventful stage 1 and 2 revision procedures. The mean time between first and second

stage procedure was 8.8 months (range, 5.6 to 21.3 months). The graft material was easily identified at the second stage procedure by its necrotic appearance with empty osteocytes lacunes within the trabecular bone. In all tissue samples predominately lamellar host bone apposition was seen on the surface of graft fragments known as creeping substitution. Separate bone graft fragments were bridged by newly formed woven bone. In 2 subjects, small islands of chondral cell differentiation were seen, indicating endochondral ossification. Active bone remodeling through combined osteoclastic and osteoblastic activity was present in 3 subjects, suggesting more advanced phases of graft incorporation. Mean bone volume was 68% over tissue volume (range 33-92%), and graft volume over bone volume was 41% (range 19-70%). Analysis of graft volume in relation to timing of second stage procedure could not demonstrate a difference in biopsies take <7 months (mean graft volume 44%, range 19-70 %) and biopsies take >10 months (mean graft volume 34%, range 19-48%).

CONCLUSIONS

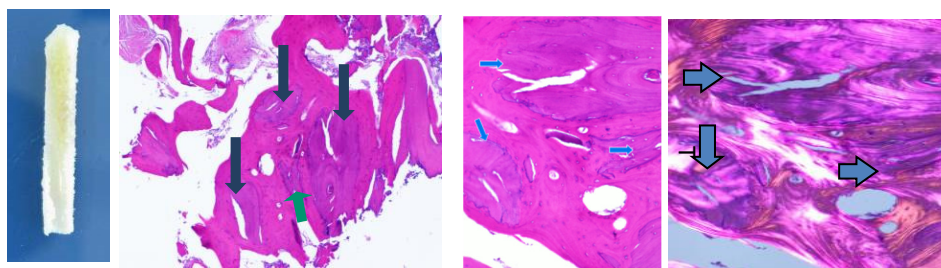
The osteoconductive SCCO2 sterilized bone allograft acted as an effective structural framework, allowing for successful graft incorporation through creeping substitution. The initial bone apposition on and bridging of graft fragments provides early mechanical strengths to facilitate two-stage revision ACL reconstruction.

Presented at:

- Australian Knee Society ASM, 15-18 October 2015, Byron Bay, Australia
- 2016 APKASS Congress, June 9 -12, 2016, Hong Kong – Macau

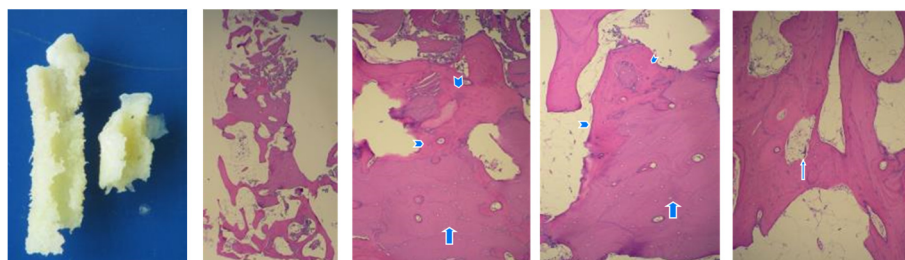
Accepted for publication

- Arthroscopy Journal 2017



Sclerotic trabeculum with necrotic lamellar (arrows) bone bordered by lamellar and woven viable host bone

necrotic lamellar (arrows) bone bordered by lamellar viable host bone



Bone with sclerosis, low power

Sclerotic areas with necrotic paler compact lamellar (arrows) bone bordered by lamellar and woven viable host bone (arrowheads)

osteoblastic and osteoclastic remodelling (arrows)



NORTH SYDNEY ORTHOPAEDIC & SPORTS MEDICINE CENTRE