Osteochondral Allograft Matching by Radius of Curvature

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Introduction: Osteochondral allograft transplantation (OCA) is the current gold standard for the treatment of articular cartilage defects with associated subchondral bone loss. OCA offers a method of bony defect replacement as well as live chondrocyte implantation and its use has become more prevalent within the United States with utilization increasing up to 500% in some prominent tissue banks. However, allograft expiration prior to implantation remains an issue with some tissue banks reporting rates as high as 13% of all donor grafts wasted. There are two problems that contribute to this loss, timing and size matching. Traditionally, grafts are requested that match for size, side, and site. For example, a patient with a right knee MFC defect would be radiographed and the X & Y dimensions of the condyle are sent to the tissue bank to await the availability of an orthotopic allograft that matches within +/- 2mm. This degree of specificity adds to the waiting time for patients and also the likelihood of an allograft expiring due to no recipient match. We hypothesize that for a given condylar defect, appropriate grafts may be found in different sized knees and/or non-orthotopic sites using a radius of curvature (ROC) matching method.

Methods: Human fresh frozen cadaveric distal femurs (12) were obtained and articular surfaces were inspected to ensure no visual evidence of chondral degeneration or injury existed. Each specimen was radiographed and measured in the sagittal and coronal axis using conventional methods. The femurs were then separated into small, average, and large groups and laser scanned to generate 3D computer models. CAD modeling software was used to divide the medial and lateral condyles into 3 weight bearing zones each (Fig.1). A virtual defect of three different sizes (20mm, 25mm, 30mm) was then created in each section of a representative specimen from each group. The surface curvature was measured in the sagittal and coronal planes for all specimen zones and grafts having an offset or recess of less than 1mm were considered to be an acceptable match.

Results: Defects created in the MFC middle weight bearing zone were matched using the conventional method and compared to the radius of curvature method. A significantly greater number of matches were found for each defect size using the ROC method than when compared to the conventional x-ray method (30mm P=0.0158, 25mm P=0.0004, and 20mm P=0.0002). The radius of curvature method was also compared to itself. It was found that the 20mm group had significantly more matches than the 25mm or 30mm group. No significant difference was found when comparing the 25mm to the 30mm group.

Discussion: This current describes a technique that would increase the number of recipient matches in OCA. In our unmatched group of 12 femoral condyles, a donor site could be found 100% of the time when the defect was 20mm in diameter. When the defect was increased to 25mm, a match was found
>90% of the time. This has the clinical potential to enhance the efficiency of tissue banks by theoretically increasing the number of donor-host matches thereby minimizing the number of specimens lost to expiration.

**Significance:** The current study illustrates a new technique that could increase the host/donor matches in OCA, by expanding upon the current standard of sized matched orthotopic locations.

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Fig 1. Typical laser scanned distal femur with reference geometry defining zones of weight bearing

Fig 2. Percentage of allograft matches per defect size and site.

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