Subchondral Bone Mismatches In Osteochondral Allograft Transplants For Large Oval Defects Of The Medial Femoral Condyle: Comparison Of Lateral Vs. Medial Femoral Condyle Donors

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Summary:
Using contralateral lateral femoral condyle osteochondral allografts does not significantly change subchondral bone alignment compared to medial femoral condyle (MFC) osteochondral allografts for large osteochondral defects of the MFC.

Data:
Introduction: In order to improve the supply-demand mismatch of medial femoral condyle (MFC) osteochondral allografts (OCA), our previous work has demonstrated that oval contralateral lateral femoral condyle (LFC) OCA can attain an acceptable cartilage surface contour match compared to an oval ipsilateral MFC OCA for large oval defects of the MFC. Additional prior work in the patella demonstrated that differences in underlying subchondral bone contour between homologous and non-homologous OCA may be larger than seen on the cartilage surface. These differences could result in abnormal force attenuation/distribution, possibly leading to earlier allograft failure. The purpose of this study was to use surface contour mapping to determine if using a contralateral LFC vs ipsilateral MFC OCA plays a role in the alignment of donor to native subchondral bone when treating large osteochondral defects of the MFC. Methods: 30 fresh frozen human femoral condyles were matched by tibial width (±2mm) into 10 groups of three condyles (1 MFC recipient, MFC donor and LFC donor) each for three fellowship-trained cartilage surgeons (90 condyles total). The recipient MFC was initially imaged using nano-CT. Commercially available instruments were used to create 17x36mm “defects” in the recipient MFC and harvest complement donor grafts from each matched donor condyle. Following the first transplant (randomized MFC vs LFC), the recipient condyle was imaged and superimposed on the native condyle nano-CT scan. The donor plug was carefully removed and the process was repeated for the other donor. Dragonfly 3D and Excel were used to determine the root mean square (RMS) of both the surface height deviation and circumferential step-off height deviation between native and donor subchondral bone surfaces for each transplant. Results: There was no statistically significant difference in mean subchondral bone surface deviation between contralateral LFC and ipsilateral MFC plugs (LFC = 0.87 ± 0.22mm, MFC = 0.76 ± 0.24mm, p = 0.07). At the interface between donor plug and the surrounding native subchondral bone, there was no significant difference in circumferential step-off height between the LFC and MFC plugs (LFC = 0.93 ± 0.18mm, MFC = 0.85 ± 0.21mm, p = 0.09). Additionally, when comparing each transplant by quadrant (anterior, posterior, medial, lateral), there were no statistically significant differences in surface deviation and step-off height. There were no significant differences in outcomes between surgeons. Discussion: Using a contralateral LFC or ipsilateral MFC oval donor plug did not lead to statistically significant differences in subchondral bone surface height deviations or circumferential step-off height at the graft/native subchondral bone interface. The acceptable subchondral bone match of LFC allografts to the native MFC surface for oval shaped lesions helps address concerns of donor tissue availability. Finite element analysis is now required to determine how differences in subchondral bone surface height in allograft compared to surrounding native bone may affect local force distribution. Clinical Relevance: Our findings support the use of size-matched non-orthotopic LFC grafts for large oval defects of the MFC. This may promote economic use of available resources without compromising the efficacy of restoring the femoral articular surface.