



Assessing Cartilage Repair using MRI

Cartilage defects can be caused by various conditions in the joint, including joint malalignment, osteoarthritis and acute injuries. The assessment of these cartilage injuries and the resultant cartilage repair tissue is best analyzed using Magnetic Resonance Imaging (MRI).

VirtualScopics is using medical imaging and the guidelines proposed by the International Cartilage Repair Society (ICRS) to help pharmaceutical companies and medical device developers better understand and assess the effects of their compounds in clinical trials. *We have conducted over 50 osteoarthritis studies, from pre-clinical to Phase III, and analyzed more than 4000 knee images.* Our patented algorithm-based approach enables us to quantify the size of cartilage defects and several characteristics of the resulting repair tissue. In addition to structural measurements such as volume, thickness and surface area, there are several scoring systems that we employ to assess the repair tissue and the overall health of the joint. By implementing more advanced imaging techniques, we can quantify the composition and quality of the repair tissue.

Structural Measurements

VirtualScopics conducts structural measurements in cartilage repair trials that can provide information about the size of the defect, the amount of repair tissue, and any changes to the thickness or volume of the surrounding cartilage. We can provide the following measurements:

Defect at baseline

- Volume of the cartilage or subchondral bone defect
- Thickness of the cartilage defect
- Surface area of the denuded subchondral bone

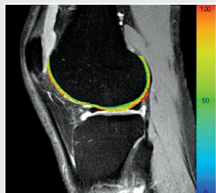
Repair tissue at follow-up

- Volume of the repair tissue
- Thickness of the repair tissue
- Percentage fill of the defect
- Bone-Repair tissue interface surface area
- Articulating surface area

Surrounding cartilage

- Volume
- Thickness
- Bone-Cartilage interface surface area
- Articulating surface area

Composition of the Repair Tissue:



While structural measurements can quantify the amount of repair tissue that has grown, they do not provide information as to its composition. As such, VirtualScopics utilizes techniques such as T2 relaxation time (related to hydration and collagen orientation) and delayed Gadolinium-Enhanced MRI of Cartilage (dGEMERIC) (related to proteoglycan content) to assess the new tissue composition.

The key to implementing the above techniques in a study is to ensure the consistency and reproducibility of the images across all study sites. VirtualScopics does this by providing phantoms that are imaged with each subject allowing us to precisely calibrate the images received from the different study sites. This sets VirtualScopics apart from other imaging core labs as we are able to gather more precise, consistent and reproducible measurements across multiple sites.

Scoring Options

Our in-house imaging experts utilize the Magnetic Resonance Observation of Cartilage Repair Tissue (MOCART) scoring technique to assess the following:

- Degree of defect repair and filling of the defect
- Integration of the repair tissue with the adjacent cartilage
- Surface appearance of the repair tissue
- Homogeneity of the repair tissue
- Whether the subchondral lamina is intact
- Condition of the adjacent subchondral bone
- Adhesions to the repair tissue
- Presence of synovitis/joint effusion

In addition, there are two scoring systems that look at the overall health of the joint:

- Whole-Organ Magnetic Resonance Imaging Score of the knee (WORMS)
- Boston-Leeds Osteoarthritis Knee Score (BLOKS)

Both of these scoring systems examine:

- Cartilage
- Bone marrow lesions
- Osteophytes
- Menisci
- Ligaments
- Synovitis/Joint effusion

Reliable Compliant Systems

Regardless of the assessments performed, VirtualScopics utilizes a **21 CFR Part 11 compliant** system to analyze images of the knee. For the structural and compositional measurements, algorithm-based technology is used to assist the analyst in determining the regions of interest. This leads to improved reproducibility, which is crucial when assessing the impact a sponsor's biologic or device is having upon the treatment of a defect.

With extensive imaging knowledge and experience with cartilage repair and other musculoskeletal studies, our ability to minimize data variability across multi-center trials, our global reach and a strong, proactive project management team, VirtualScopics provides the most comprehensive imaging solution for your cartilage repair studies.

Additional VirtualScopics Imaging Services to support your cartilage repair studies:

Pre-Study Services

- Modality selection - CT, MRI, X-Ray, DEXA
- Standardization across global imaging sites
- Clinical protocol design support, including image-based biomarker and image modality selection
- Independent review charter development (Imaging charter)
- Special protocol assessment (SPA) development
- Statistical analysis plan development support
- Imaging site qualification, initiation and training
- Method, proof-of-concept and pilot studies
- Support at regulatory meetings

Study Services

- Ongoing image site management
- Image data quality control and inspection
- Regulatory-compliant image data management processes
- State-of-the-art image analysis techniques
- Traditional image-based biomarkers
- Novel quantitative biomarkers
- Image data results delivered to your specifications
- Medical and scientific reports

Post-Study Services

- Secure image data management and archiving
- Statistical analysis and mining of image data
- 3D & 4D visualization of results
- Image data regulatory submissions

For more information on how we can accelerate your clinical trials with our industry-leading technology, Call us at +1 585.249.6231. Or visit www.virtualscopics.com.