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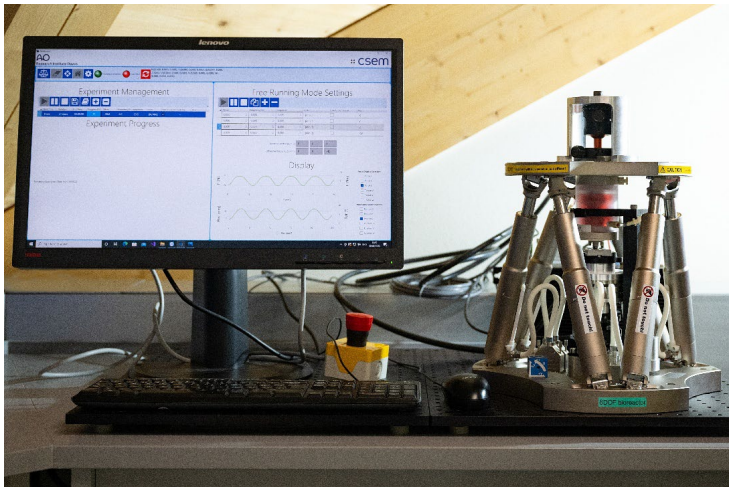
Research in Graubünden

Research for Healthy Intervertebral Discs

Bioreactors Enable Realistic Testing Conditions

Injuries and diseases affecting cartilage and intervertebral discs present major challenges for medicine, as these tissues have very limited self-healing capabilities. That is why researchers in Davos are working intensively on effective therapeutic approaches. A key role in this research is played by bioreactors, which allow scientists to simulate cell behavior under realistic conditions.



The movement and loading pattern of the multi-axial bioreactor is controlled by software.
Image: AO Foundation Communication & Events

Pharmacist and biologist Sibylle Grad has been researching cartilage and intervertebral disc regeneration at the AO Research Institute Davos (ARI) for almost 25 years. “Simple cell cultures in Petri dishes often do not provide the realistic results we need,” Grad explains. In contrast, bioreactors allow researchers to study cells under mechanical stress—a crucial factor, as movement significantly influences cell biology. “We are investigating how cartilage cells respond to different types of mechanical load, when movement promotes healing, and when it causes harm,” she says.

The ARI has already developed several bioreactors, including a model for the knee joint that simulates both compressive loads and shear forces. An advanced model for intervertebral discs has since been developed. The latest generation of these bioreactors can simulate movements in six degrees of freedom: forward and backward, up and down, left and right, as well as rotational movements. This system was created as part of an SNF project in collaboration with ETH Zurich and CSEM Neuchâtel.

A crucial aspect of the research involves biological samples. Sibylle Grad and her team obtain fresh intervertebral discs from cow tails at the meat processing center in Klosters. “The cells must still be alive. That’s why we collect the samples immediately after slaughter,” she explains.

A major issue with degenerative intervertebral discs is the drying out of the gelatinous core. Stem cell therapies offer promising approaches, but clinical studies have so far yielded inconsistent results. “We are investigating under which conditions stem cells survive and remain active in the intervertebral disc,” reports Sibylle Grad. Her research group is working with TU Wien, which is developing specialized cell carriers to stabilize the cells within the disc. Another field of research is the pain response of the intervertebral disc. Grad’s team co-cultivates intervertebral discs with nerve cells to understand which cell types are responsible for pain transmission.

Research in Davos has made impressive progress over the past decades. “In the past, Davos was primarily known as a winter sports resort. Today, it is also recognized as a renowned center for science,” says Grad with enthusiasm. The planned new construction of the AO Science Cycle will offer cutting-edge research facilities and further drive development.

In addition to her research, Grad teaches as a professor at ETH Zurich and is committed to Academia Raetica, which connects researchers in Graubünden. Despite her many responsibilities, she still finds time for balance: “Cross-country skiing during lunch breaks or yoga in the evening are my secret weapons,” she reveals.

Sibylle Grad and Daniela Heinen

AO Research Institute Davos
The AO Research Institute Davos (ARI) holds a leading global position in preclinical research for trauma surgery and orthopedics. The research conducted at the headquarters in Davos significantly contributes to the recognition of Davos as a renowned research hub. www.aofoundation.org

Sibylle Grad
Image: AO Foundation Communications & Events

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