

Mesenchymal stem cells to improve regeneration after joint-preserving knee surgery

The development of knee osteoarthritis is often the consequence of a congenital or acquired deformity of the lower leg or a consequence of meniscal tears. The most common cause are knock-knees or bowlegs or a lateralisation of the patella. Due to the deformity, some areas of the knee are subjected to increased mechanical load on the cartilage, whereas other areas are less loaded. Further causes of excessive load on the cartilage are parts of the meniscus that dislocate after meniscal tears in the joint. Excessive mechanical load leads to degenerative changes of the cartilage and to an inflammation which in turn results in changes of the whole joint including the synovial membrane, the bone and the capsule, causing osteoarthritis of knee. As a reaction to the thinner chondral layer, a bony overgrowth with formation of osteophytes occurs. These additionally compromise the range of movement of the joint.

Osteotomies of the bones around the knee can correct these deformities and reduce the mechanical load on the cartilage in the joint. The knock-knee or bowleg deformity can be corrected through osteotomy of the knee and fixation of the bone in a correct position. Meniscal tears and osteophytes can be treated by a minimally invasive surgery with arthroscopy, thereby reducing the mechanical load on the cartilage.

However, cartilage damages tend to progress even if the mechanical loads in the knee joint are normalized. This is especially the case in patients who already show a progressive degeneration of their chondral layer. The progression may require the implantation of a knee prosthesis. The reason for this progression after correction is not yet known, a biological reason is probable. Current research hypothesizes that focal damage to cartilage leads to a progressive degenerative reaction that affects the entire joint. This degeneration seems to continue in some patients even after the mechanical load has normalized. Beside the mechanical correction, the knee joint needs a biological therapy with “rejuvenation” to stop the progression of the osteoarthritis.

Mesenchymal stem cells (MSC) have been the focus of orthopaedic research in recent years. They are located in the mesenchyme (connective tissue such as muscles, fat and bone) as silent stem cells close to the blood vessels and often wait years before they are needed. If the tissue is harmed, stem cells are required. These cells are also called mesenchymal stoma cells. In patients with osteoarthritis, there are not enough cells that are attracted to the joint. Numerous high qualitative studies have shown a reduction in the progression of osteoarthritis and pain through the use of MSCs (1-7). They can differentiate into host tissue (cartilage), however new research shows that the cells act as sensors and take over the role of regulators. They activate the help, reanimate the local cells and coordinate a cellular and enzymatic cleaning of the tissue as well as try to limit the tissue damage. Furthermore, MSCs attract new cells that build blood vessels, they promote the development of regenerative tissue and cooperate in a limited manner in this part (8).

This effect seems to be missing after the surgeries described above and is probably the reason for the progression of osteoarthritis. Studies have shown improved outcomes after injection of MSCs after joint preserving knee surgery (9-11).

At ECOM we treat patients with MSCs derived from the fatty tissue. In a very short anaesthesia 50-100 ml of fat is suctioned from the belly. Through a complex but standardised process, the fat is treated mechanically and with a special enzyme. In this way, over 10 million MSCs can be extracted after 1 hour and applied to the joint (12,13). The cells can also be injected after joint surgery. Four to six weeks after the operation, the cells are harvested and applied. This optimises the biological milieu in the joint and thus improves the regeneration of the joint and resistance to the development or progress of osteoarthritis. The intervention can be performed as an outpatient procedure. After the treatment, no restriction regarding the weight load of the leg is necessary. In the first four weeks after the injection, sports activities are not recommended.

LITERATURE

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