Leibniz-Institut für Polymerforschung Dresden

DRESDEN concept

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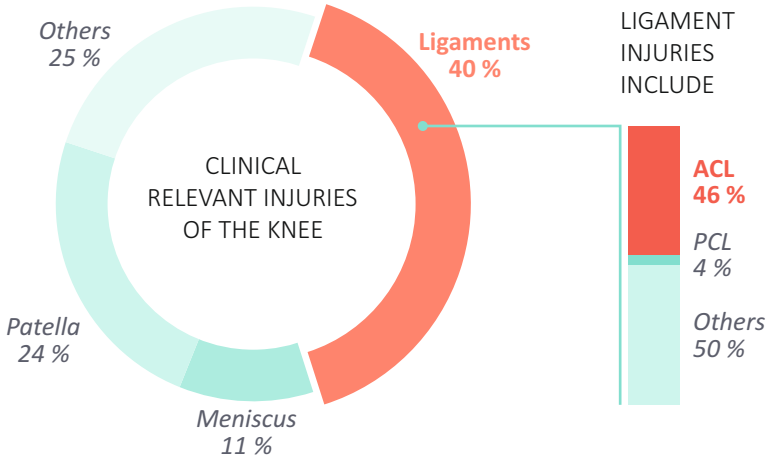
EMBROIDERED MEDICAL TEXTILES

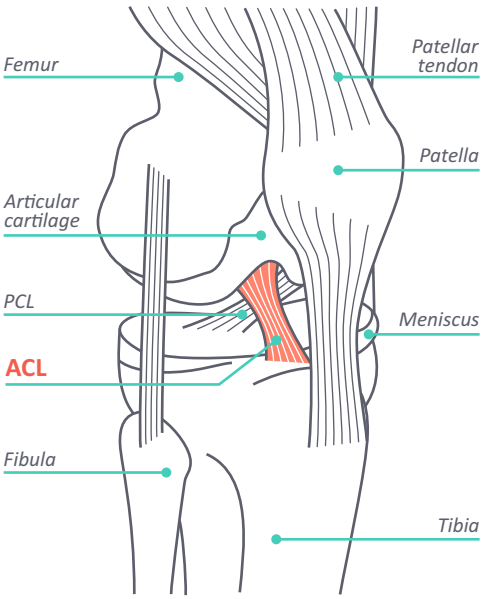
Reconstruction of the Anterior Cruciate Ligament (ACL)

The reconstruction of lost tissue function of a ruptured anterior cruciate ligament (ACL) is inevitable to restore the dynamic stabilization of the knee.

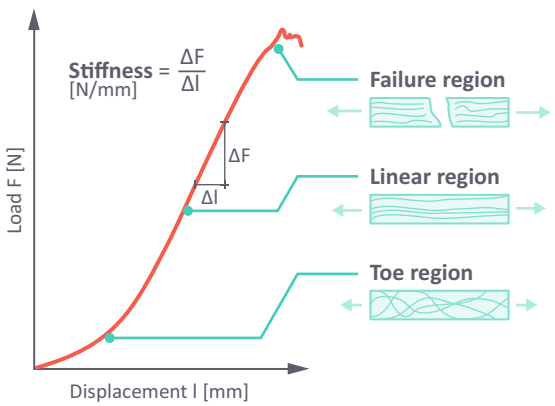
The majority of knee injuries is related to lesions of the ligamentous structures ACL, PCL (posterior cruciate ligament) and other complex injuries.
[chart below adapted from DOI 10.1136/bjsm.34.3.227-a]



The ACL is located inside the knee joint and consists of a ligamentous zone, an enthesis and a direct insertion into the bone.



The fiber bundles of the ACL exhibit a specific behavior under uniaxial static loading resulting in a typical load-displacement diagram (red curve).



Embroidery technology offers the possibility to design and fabricate a triphasic scaffold that fits the individual claims of the three structural zones (1) **Ligament**, (2) **Enthesis** and (3) **Bone Insertion**.

Mechanical and structural properties can be mimicked and the conditions that the specific cell types of ligament, enthesis and bone insertion need to proliferate and differentiate can be complied.

1 Ligament

Adjustment of the stress-strain behavior to native tissue

Porosity > 70 %
Pore sizes 100–150 µm

2 Enthesis

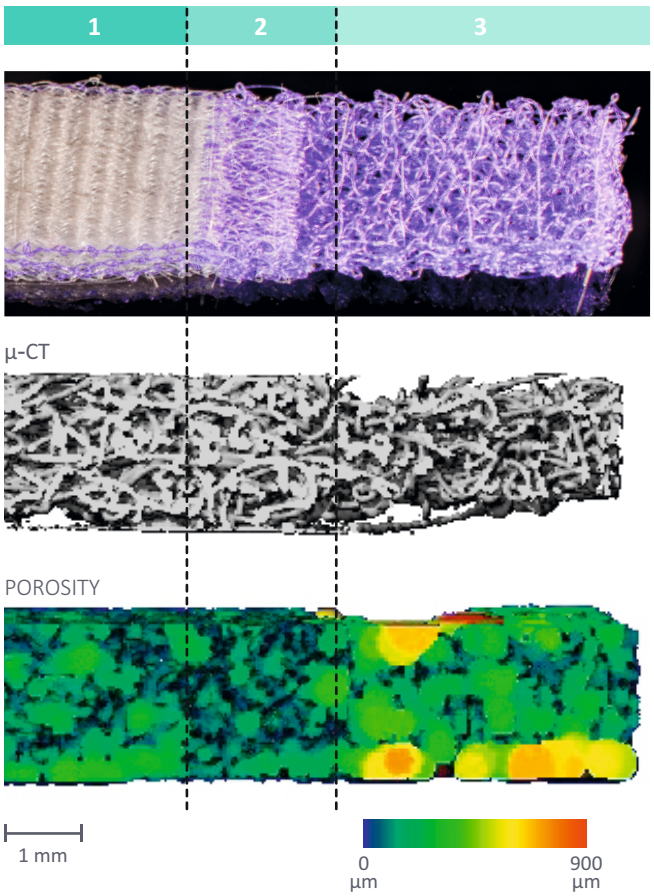
Stiffness gradient from bone to soft tissue

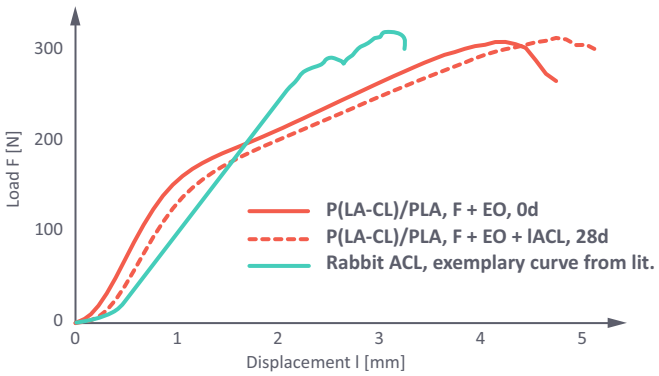
Porosity > 75 %
Pore sizes 150–250 µm

3 Bone Insertion

Structural integrity and bone anchorage

Porosity > 80 %
Pore sizes 250–350 µm





The developed ACL scaffold was made of poly(lactic-co-caprolactone) (P(LA-CL)) and polylactic (PLA) thread materials with a fluorination (F) and an Ethylene oxide sterilization (EO). It demonstrates an adapted load-displacement behavior after 28 days in vitro cultivation with lapine ACL-cells comparable to native tissue of the rabbit ACL. [A. Breier et al. (2018) Tissue Engineering einer vorderen Kreuzbandplastik auf der Basis resorbierbarer, gestickter Träger. Teil 1: Gestaltung einer mechanisch angepassten triphasischen Scaffoldstruktur, Gummi Fasern Kunststoffe 71 (11) 582–587]

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