Musculoskeletal injuries and degenerations, such as sport-related tendon or ligament ruptures and articular cartilage and osteochondral defects and age-related osteoarthritis, are a common and urgent problem in all current societies and especially in Europe with its aging population. Due to the related pain and poor healing, they often require surgical treatment. Since natural healing processes and current clinically available reconstruction techniques (e.g. bridging of tendon defects with the use of sutures) are not very successful, researchers are looking for alternatives and interface tissue engineering emerged in recent years as a promising approach. This discipline aims in obtaining in the laboratories constructs that can mimic complex native tissues in regard to their structure and function. In this context, 3D printing technologies offer powerful and promising opportunities to produce novel, tissue- and patient-specific biodegradable scaffolds and tissue constructs which, after implantation, can support complete defect regeneration in the body.

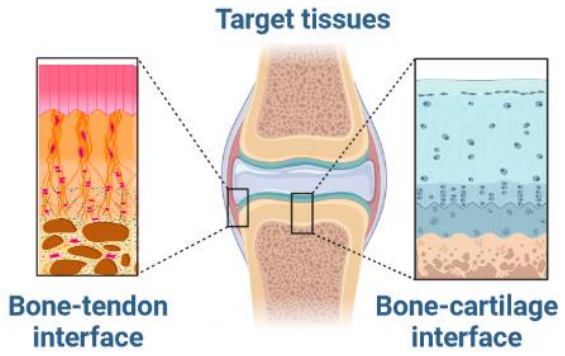


**Fig. 1:** Schematics of the tissues that will be reconstructed in the project (created with Biorender.com).

Therefore, the present, international proposal aims in creating new types of implants and tissue constructs that support full regeneration of common defects that occur at tissue interfaces in musculoskeletal tissues. Specifically, we will target two tissue types (see Fig. 1): bone-cartilage and the tendon-bone connections. In our studies we will utilize 3D printing techniques for the productions of those engineered tissues.

To achieve the goal, a complete set of research will be performed. First, we will propose different structural design variants to support cell growth within the scaffolds and provide structural and mechanical properties similar to that of the native tissues. We will propose alternative architectures to the ones commonly used in 3D printing nowadays. Second, we will identify or develop suitable biomaterials for printing of these designs. Finally, we will combine different, state-of-the art printing technologies to build up close tissue mimics. We will also use computational modelling to predict the mechanical properties of the printed structures.

Proposed approach will allow the fabrication of hierarchically organised constructs and can be easily translated to other complex tissues in the human body. It has a high societal relevance and is targeting currently unmet clinical needs for functional implants and *in vitro* tissue models of complex interfacial tissues. Additionally, we will benefit other scientific disciplines by providing new printing patterns and functional designs and computational models to predict printed constructs' properties.