



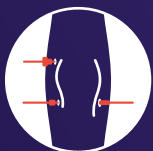
#### WHAT'S HAPPENING?

An untreated or not-correctly treated **joint injury** will most likely progress towards **osteoarthritis**.



#### WHAT'S BEING DONE?

The articular cartilage assessment during arthroscopic surgery is solely based on **visual inspection** (video) and **manual probing** of the stiffness hindering the intra-operative decision making.



#### WHAT'S THE SOLUTION?

MIRACLE will develop the first **mid-infrared attenuated total reflection (MIR-ATR)** probe capable of quantitative and real-time assessment of articular cartilage during arthroscopic surgery.



#### WHAT'S NEXT?

MIRACLE will enable **accurate evaluation** of the articular cartilage during arthroscopy, assisting the orthopaedic surgeon in more objective decision making and promoting patient well-being.

#### CONSORTIUM



[www.miracleproject.eu](http://www.miracleproject.eu)



This project received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 780598. The project is an initiative of the Photonics Public Private Partnership



# COMBINING TECHNOLOGIES. CREATING SOLUTIONS.

## MID-INFRARED ARTHROSCOPY IMAGING SYSTEM

## FACTS ON OSTEOARTHRITIS



Affects 242 million people globally



50% of people over 65 affected worldwide



Estimated 8.9 years delay in diagnosis



€1330-€10,452/year per patient in EU

These facts clearly support efforts taking on the challenge of developing accurate diagnosis tools for in-depth evaluation of the articular cartilage.

MIRACLE consortium members have promising results demonstrating the great potential of using a MIR-based system as a diagnostic tool.

## BACKGROUND

### ✓ *MIR spectra*

The University of Oulu has demonstrated experimentally that the MIR spectra extracted from the superficial layer of articular cartilage can be used to assess the Osteoarthritis (OA) status of the joint and are correlated with the histopathological grading of OA (OARSI grade) providing proof of concept for the diagnostics approach.

### ✓ *MIR based probe*

*art photonics* has developed and demonstrated experimentally a MIR-based probe capable of evaluating the biochemical composition of tissues, with potential use for future *in vivo* diagnostic applications.



Arthroscopy

## WORK IN PROGRESS

### ☀ *Tailored laser light source*

Specific quantum cascade lasers (QCL) light source to examine articular cartilage, with the potential of being used in other medical applications.

### ☀ *Beam combiners*

An unique on-chip beam combiner (iBeam) to act as the optical interface between the QCL based light source and the waveguide.

### ☄ *Waveguides (for spatial resolution)*

It will enable the probe to acquire resolved MIR spectra allowing for mapping (i.e. imaging) of the area under investigation.



Photonics



iBeam

### ☄ *System integration*

All the components will be integrated within an efficient optical interface in existing formats for arthroscopic tools, aiming at the reduction of manufacturing costs and equipment efficacy (ISO-13482 compliant).

### ☄ *Multivariate modelling*

Data will be integrated into a software interface providing surgeons with an automated analysis, evaluation and classification of the information.



Waveguides



Multivariate modelling



MIR-ATR



Accurate diagnosis

## THE FUTURE

### ☄ *MIR-ATR based probe*

The prototype developed in MIRACLE will be validated and demonstrated during arthroscopic surgery by highly competent human and equine orthopaedic surgeons, paving the way for market entry. By bringing this diagnostic tool to the market, MIRACLE will not only impact on surgeons' routines and patients' lives, but will also place Europe at the forefront of photonic technologies and medical equipment industry.