LASER POLARIMETRIC ASSESSMENT OF HUMAN SYNOVIAL FLUID AT MACROMOLECULAR LEVEL

Vasylchyshyn Y.M., Kvasniuk D.I., Vasyuk V.L., Pilipchuk T.P.
Bukovinian State Medical University, Chernivtsy, Ukraine

Key words: Laser polarimetry, arthritis, synovial fluid,

Introduction

The work presents our first experience in studying human synovial fluid in normal and pathological state by applying laser polarimetry to determine the nature of pathological changes.

Diagnostic arsenal available for recognizing joint injury and diseases includes several physical methods such as conventional roentgenography, computed tomography, magnetic resonance imaging, ultrasound etc. However, none of the above assesses structural changes in synovial fluid at macro- or micromolecular level, which is important for differential diagnosis.

Methods

Search for such diagnostic tool lead to introduction of laser polarimetry to joint disorders diagnostics. It provides several new parameters for biological tissues assessment at subcellular level.

Aim

Goal of the research was designing a technique for polarimetric assessment of human synovial fluid at macromolecular level to recognize its structural changes and physiological state in osteoarthritis, rheumatoid arthritis, septic arthritis, and gout arthritis.

Human synovial fluid is optically complex, containing three main components:

1) Optically isotropic – optically homogenous component with high general protein and lactic acid level and low glucose level that includes hyaluronic acid in complex with proteins and large amount of leukocytes

2) Optically anisotropic – liquid-crystal phase containing several types of liquid crystals: fibrin filaments, collagen fibers

3) Optically anisotropic – solid crystal phase formed by cartilage and synovial debris.

Basing on the synovial fluid structure described above, distinct trends can be recognized at its exposition to laser beam. Polarimetric maps can be obtained and compared for synovial fluid in a healthy joint, osteoarthrosis and reactive arthritis.

Results

Comparative analysis of complex polarization laser images of human synovial liquid smears showed the following:

1. Intensity distribution is coordinately inhomogenous with optically isotropic and optically anisotropic (liquid-crystal phase) components.
2. Laser imaging performed by transmitting the polarizer and the analyzer at crossed planes allows to visualize coordinately the distribution of liquid-crystal phase.
3. The objective criteria for diagnosis and differentiation of osteoarthritis, reactive arthritis are defined based on rank 1 - 4 statistical moments of laser images.

Therefore, laser polarimetry allows to distinguish the optical patterns characteristic for certain joint disorders by selection laser polarimetry imaging of synovial fluid smears.