Articular Cartilage
Structure, Biochemistry and Metabolism

An Essay
Submitted for the Partial Fulfillment
of the Master Degree in Orthopedic Surgery

By

Tamer Ibrahiem Sherief

M.B., B.Ch.

617.472
T.1

5u855

Supervised by

Prof. Dr. Mohammed Maziad

Professor of Orthopedic Surgery
Ain Shams University

Prof. Dr. Sameh Shalaby

Assistant Professor of Orthopedic Surgery
Ain Shams University

Ain Shams University
Faculty of Medicine
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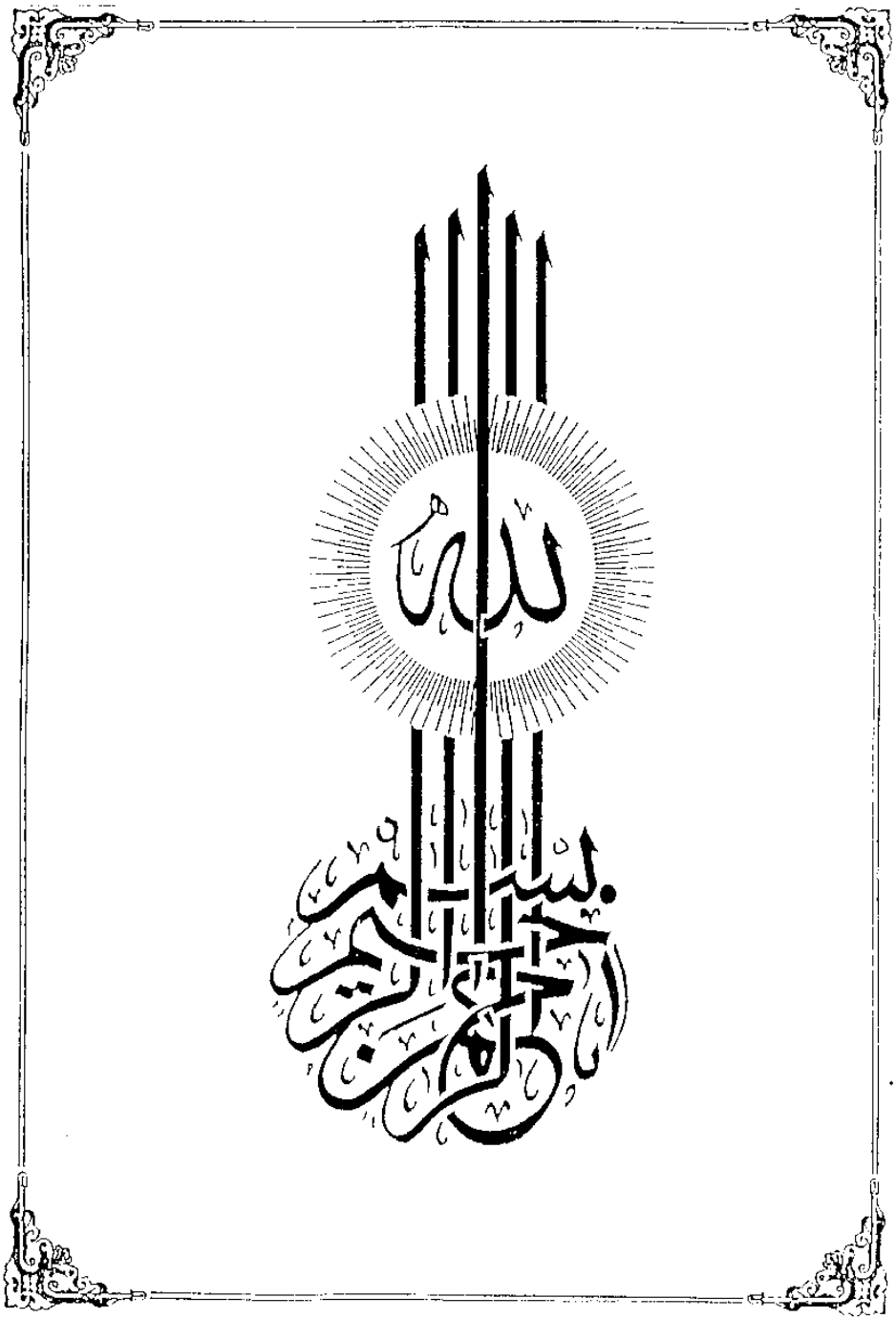

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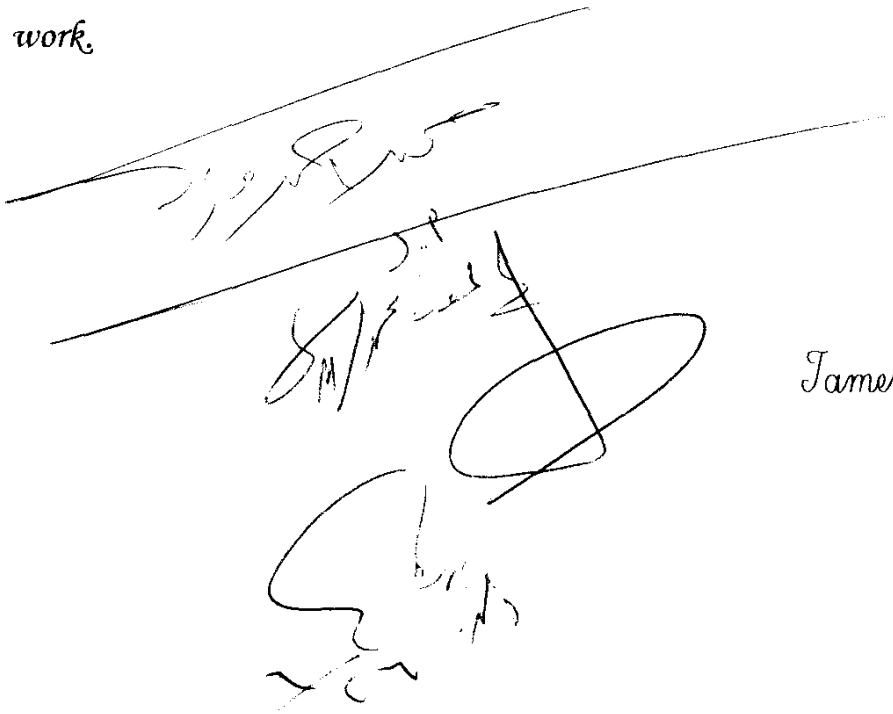

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Introduction

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Introduction

Articular cartilage, the resilient load bearing material of diathrodial joints, provides joints with excellent friction, lubrication and wear characteristics required for continuous gliding motion.

It also serves to absorb mechanical shock and spread the applied load onto the bony supporting structures below ***(Mankin et al., 1993).***

Under normal physiologic conditions, articular cartilage can perform these functions with little damage over seven or eight decades. However, this tissue may be damaged by trauma or by chronic and progressive degenerative diseases ***(Schenk et al., 1986)***. Although articular cartilage is a metabolically active tissue, it has little capacity for repair ***(Buckwalter and Cruess, 1991).*** New research on articular cartilage, based on recent advances in the understanding of articular cartilage biology, composition, metabolism, molecular and structural organizations and biochemical properties, offers hope for the development of biologically based repair procedures as alternatives to prosthetic joint replacement in the treatment of degenerative joint diseases and joint injuries ***(Heminen et al., 1987).***

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Thus, it is important to provide a firm understanding of the structure and function of normal articular cartilage. In this work, we will try to explain the various aspects of articular cartilage biology. This includes a detailed description of the structure biochemistry and metabolism with explanation of the different control mechanisms on the metabolic pathways. There will be also a little hint on the effect of aging on articular cartilage with a brief comparison between these aging changes and the degenerative changes that occur in osteoarthritis.

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Structure of articular cartilage

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Structure of the articular cartilage

Articular cartilage is formed of hyaline cartilage which microscopically has a glassy appearance because the amorphous matrix has the same refractive index as the collagen (with few elastic fibres embedded in it) ***(Richard, 1983).***

Histologically it consists of relatively "few" cells with "much" intercellular matrix. Although the matrix and the cells are structurally separated they are functionally interdependent. Chondrocyte activity is necessary for the synthesis of matrix and probably for its physiological degradation ***(Mankin and Lipiello, 1969).***

Inturn the matrix plays an important part in maintaining the homeostasis of the cell environment ***(Gresh and Catchpole, 1960).***

Articular cartilage is devoid of nerves and is generally considered to be avascular, although a few blood vessels may be found in its parts adjacent to the bone ***(Freeman, 1973)***; also, ***Sorgente et al. (1975)*** agreed that the articular cartilage is an avascular tissue and he extracted a protein from the articular cartilage that prevents vascular invasion.

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Zonal classification of articular cartilage

This classification suggested by ***Collin (1949) and McCall (1969).***

For descriptive purposes, the articular cartilage is divided into 4 zones: (Fig. 1)

Zone 1: (Superficial or tangential)

- Adjacent to the joint cavity.
- Fibres are arranged tangentially to the surface.
- Cells are discoidal with long axis parallel to the surface so, appear ovoid or elongated.
- The most superficial part of this zone is termed surface lamina or lamina splendens.

Zone 2: (Intermediate or transitional)

- Collagen fibres from a coiled interlacing network randomly arranged in relation to the surface.
- Cells are spheroidal and equally spaced.

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Zone 3: (Deep or radial)

- Fibres are thicker, form a tight meshwork and arranged somewhat radial to the articular surface.
- Spheroidal cells are larger and arranged in columnar fashion (often in groups of seven to eight cells).

Zone 4: (Calcified)

- Adjacent to the subchondral bone.
- Cells are sparse and smaller.
- Matrix is heavily impregnated with calcium salts.

The junction between the calcified and non-calcified cartilage (zone 3 and 4) is marked by a basophilic line known as the Tidemark.

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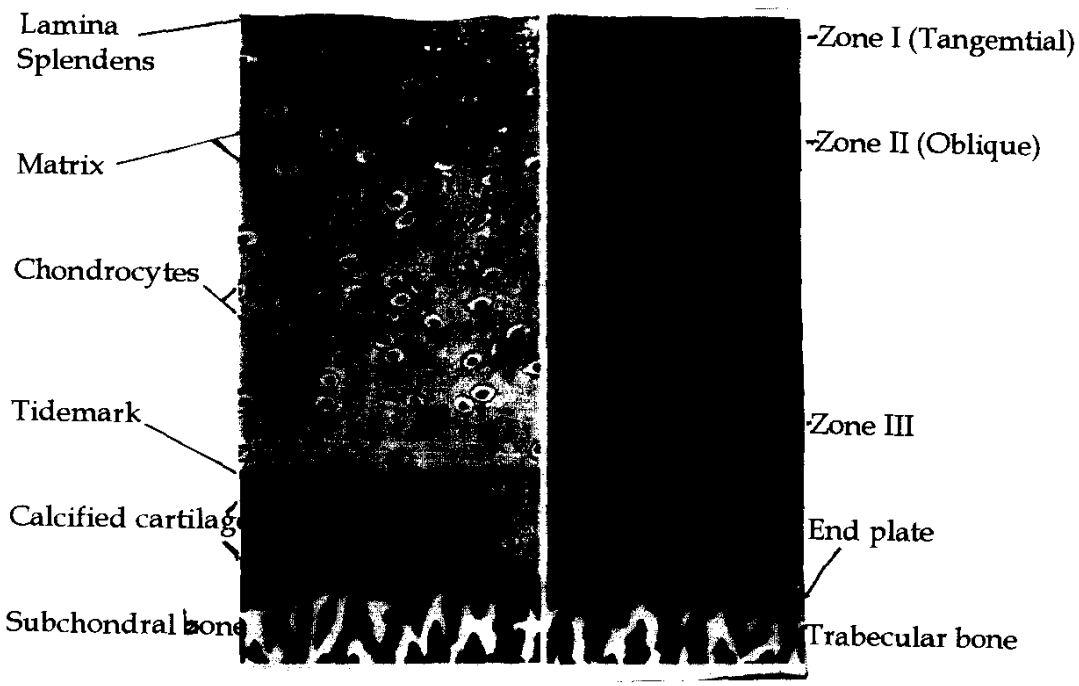

Figure (1)

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