SYNTHETIC FIBRES IN THE TREATMENT OF LIGAMENTOUS INJURIES

THESIS

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By

Abdulia Ibrahim Mahmoud

M.B., B.Ch.

SUPERVISED BY :

Dr. Mamdouh Hefny

Prof. of Orthopaedic Surgery

Head of orthop. department

AIN SHAMS UNIVERSITY

Dr. Osama Shata

Ass. Prof. of Orthopaedic surgery

AIN SHAMS UNIVERSITY

Orthopaedic Surgery Dept.

FACULTY OF MEDICINE

AIN SHAMS UNIVERSITY

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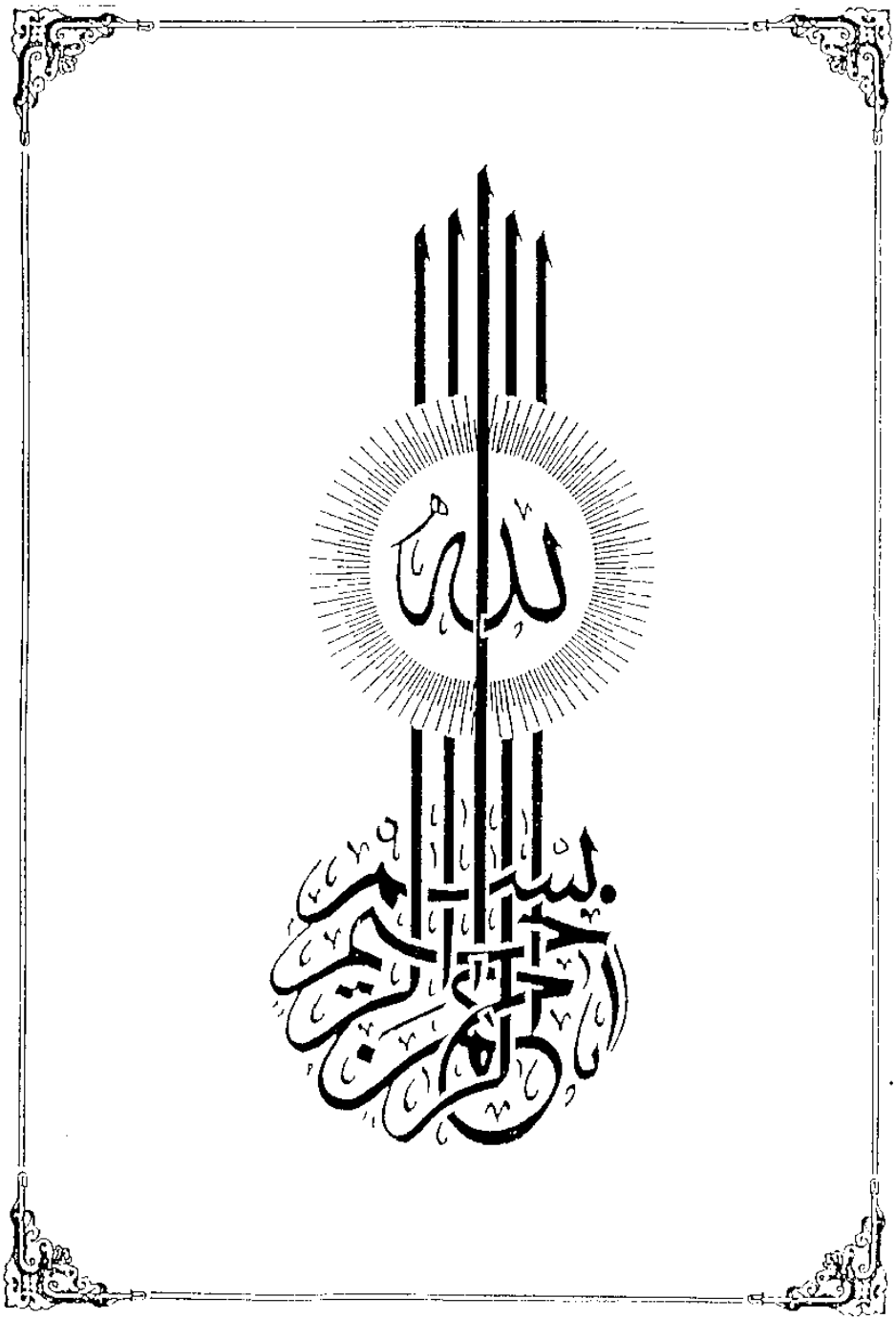

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INTRODUCTION

SYNTHETIC FIBERS

Synthetic fibers are fibers obtained from non-fibrous chemical sources rather than from natural sources such as the cellulose of plants or the hair of animals. They are strong, durable, and light weight as well as abrasion resistant, stretchable easy to dyes and resistant to heat, moisture, mildew, and chemicals. Fiber producers change the size, shape, surface, luster, and other physical aspects of synthetic fibers to create fibers for specific end uses.

Generic terms for the synthetic fibers include acrylic, modacrylic, nylon, olefin, polyester, saran, and spandex.

Individual manufactures apply trade marked names to their own form of such fibers, such as Antron, Cumuloft, Qiana, Orlon, Dacron, and Lyera.

Synthetic fibers, like other man-made types, are usually produced by converting the fiber-forming susbtances to a fluid state, frequently employing a solvent, to form a spinning solution. In the spinning or extruding operation, the solution is fed through holes in a spinneret, a device performing much the same function as the spinneret of the silk worm.

In the formation of man-made fibers, the term spinning applies to the process of forcing the solution through the spinneret holes, the same term is applied to the production of yarn by twisting together either natural or man-made fibers or combinations of both.

The emerging solution is hardened, forming a fibre having great length, called a filament, which is subjected to a stretching, or drawing, operation, increasing the aligment of its molecules. Variations and special properties can be introduced during manufacturing process.

The long filament may be used to make yarn or may be cut into short, uniform lengths forming staple and then twisted to form yarn. As the variety of new synthetic fibres increased, as various fibers were blended together, and as special finishes were applied.
(Carroll - Porczynski, C.Z. 1960).
(Dembeck, Adeline A., 1969).
(Mark, Herman F., 1967-68).
(Moncrieff, R.W. 1975).

ANATOMY

ANATOMY

KNEE LIGAMENTS:

The capsule is reinforced by four main ligaments, namely the patellar retinacula, the tibial and fibular collateral ligments and the oblique popliteal ligament.

THE TIBIAL COLLATERAL (medial) ligament:-

Is attached to the epicondyle of the femur below the adductor tubercle and to the subcutaneous surface of the tibia a hand's breadth below the knee. It is abroad, triangular band of a great strength, It's anterior margin lies free except at it's attached extremities and is not attached to the medial meniscus, being separated from it and the condyle of the tibia by a bursa, its posterior margins converge to be inserted into the medial meniscus, only those marginal fibers and no others are attached to the meniscus. Over the condyle of the tibia the ligament is separated from bone by the forward extension from the semimenbranosus tendon and the intervening bursa. Below this, over the upper surface of the shaft of the tibia, the ligament is separated from bone by the passage of the inferior

medial genicular vessels and nerve. Hence the extension of the medial ligament so far below the knee joint to find a firm attachment, the condyle of the tibia is free to rotate beneath the ligament. From its tibial attachment the ligament slopes back a little as it passes up to be inserted behind the axis of flexion of the femoral condyle. It is thus drawn taut by (and limits) extension of the knee and its terminal "Screw-home" rotation.

THE FIBULAR COLLATERAL (lateral) ligament:-

Is attached to the lateral epicondyle of the femur in continuity with the short external lateral ligament. It slopes down and back to the head of the fibula. It lies free from the meniscus by the tendon of popliteus inside the joint and the inferior lateral genicular vessels outside the joint.

It is a strong cord-like ligament. It is attached just behind the axis of flexion of the femoral condyle and is drawn taut by (and limits) extension and terminal "Screw-home" movement of the knee.

ANATOMY, OF THE ANTERIOR CRUCIATE LIGAMENT (ACL):

Is attached to the anterior part of the tibial plateau in front of the tibial spine and extends upwards and back-wards to a smooth impression on the lateral condyle of the femur well back in the inter-condylar notch,

MICROANATOMY OF THE ANTERIOR CRUCIATE LIGAMENT (ACL):

Ligament:

The ACL is made up of multiple fascicles. The basic unit of which is collagen.

Nonparallel, interlacing networks of these collagen fibrils (150 - 250 um in diameter are grouped into fibres (1 - 20 um in diameter), which in turn, compose a subfascicular unit (106 - 250 um in diameter).

These subfascicular units are surrounded by a loose band of connective tissue known as the endotenon, three to 20 subfasciculi, bound together, form a fasciculus, which may range from 250 um to several millimeters in diameters and are surrounded by epitenon.

These individual fascicles are either oriented in a spiral fasion around the long axis of the ligament or pass directly from the femur to the tibial attachment. The entire continuum fascicles, forming the ligament, is surrounded by the paratenon, a connective tissue covering similar to but much thicker the epitenon. (Arnoczky 1979, 1982).

Ligament bone attachment:

The attachment of ACL to the femur and tibia occurs via the interdigitation of collagen fibres of the ligament with those of the adjacent bone. The abrupt change from flexible ligamentous tissue to that of rigid bone is mediated by a transitional zone of fibrocartilage and mineralized fibrocartilage.

This alternation in the microstructure from ligament to bone allows for a graduated change in stiffness and prevents stress concentration at the attachment site. This zone may also impose a barrier to endosteal vessels entering the ligament at these attachement sites.

Vascular supply:

The cruciate ligaments (anterior and posterior) are covered by a fold of synovial membrane that resembles a mesentry and incompletely divides the joint in the sagittal plane. Thus, while the ligaments are intra articular, they are actually extra synovial.

The anterior cruciate ligament is covered by a synovial fold that originates at the posterior inlet of the intercondylar notch and extends to the anterior tibial insertion of the ligament, where it joins the synovial tissue of the joint capsule distal to the infrapatellar fat pad.

This synovial membrane, which forms an envelope about the ligament, is richly supplied with vessels that originate predominantly from the middle genicular artery, A few smaller terminal branches of the lateral inferior genicular artery may also contribute some vessels to this synovial plexus. These synovial vessels arborize to form a web-like network of periligamentous vessels. Which ensheath the entire length of the ligament.

These periligamentous vessels then give rise to smaller connecting branches, which penetrate the ligament transversly and anastomose with a network of endoligamentous vessels. These vessels, along with their supporting connective tissues are oriented in a longitudinal direction and lie parallel to the collagen bundles within the ligament.

The blood suppley of the ACL is predominantly of soft tissue origin. While the middle genicular artery gives off additional branches to the distal femoral epiphysis and proximal tibial epiphysis, the ligamentous osseus junction of the ACL do not contribute significant to the vascular scheme of the ligament itself.

Nerve supply:

The ACL receives nerve fibres from branches of the tibial nerve (medial popliteal nerve). These fibres penetrate the joint capsule posteriorly and course along with the synovial and periligamentous vessels surrounding the ligament.