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SHORT COMMUNICATION

Genesis of Collagen Fibres in the Dermal Tissue of Fetal, Neonatal and Adult Goat *(Capra hircus)* – A Transmission Electron Microscopic Study

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ABSTRACT

Study was conducted on 10 goat fetuses(5 from group I- CR length upto 20 cm and 5 from group II- CR length 20 cm and above), 5 neonatal goats (group III) and 5 adult goats (group IV*)* to study the configuration of collagen fibers in the skin of *Capra hircus*. Connective tissue in the dermis is composed of the fibrous proteins collagen, elastin, and reticulin in which collagen accounts for 70% of the total fibres. The observation (Transmission Electron Microscopic study) revealed that the fibre formation in the sections of group I fetuses was not apparent. In group II fetuses the collagen fibres appeared to arise at the angles of the fibroblast cell mainly in deep zone of dermal matrix. Micrographs show very clear histogenesis of fibres in this group. In group II (around 30 to 35 cm CR length) fetuses the growth in due course of time elevated very high. There is clear view of histogenesis of collagen fibres in fetal stage and remarkable changes with the growing age. The collagen assimilation was intense in group III goats coupled with a dynamic rearrangement of the tender collagen bundles in the dermal region. In group IV showing distribution of dense collagen bundles found in rigorously scattered and slack slender groups running parallel to the epidermis. In this group samples the variation is associated with a loss of fibrous tissue, slower rate of cellular renewal, and a reduced vascular and glandular network.

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INTRODUCTION

In mammalian skin, collagen is the most abundant structural constituent of the dermis, comprising about three quarters of the dry weight of this part of the integument (Mathews, 1975). The ability of skin to resist the mechanical stresses of tension and pressure results from the arrangement and tensile strength of the fibres and fibre bundles formed by this scleroprotein. From the morphological point of view, the limited elasticity and extensibility, constant tension and the shock absorption capacity of the skin depend on the three dimensional network of the collagen fibres and fibre bundles. This architecture has been investigated extensively in human skin, and has led to the description of several functional models of the mechanical characteristics of the dermis. The model concepts mostly rely on the two dimensional construction principles of a scissors lattice or a closely interwoven wire mesh, and are still under review (Imayama and Braverman, 1989).

The knowledge of collagen fibres and their architecture in the common integument of the pig is worked on by Meyer *et al.* (1978). They reported bulk of the dermis is dominated by a massive three dimensional network of collagen fibres and fibre bundles with obvious differences in body regions. The arrangement of fibre bundles are multifarious because of their multiple interactions with various other dermal components, tightly regulated developmental pattern of deposition, multi-step hierarchical assembly, unique properties and influence on cell phenotype. Here we reported the complexity of the collegen fibre system and its detailed structural analyses in various age groups of goat skin type.

MATERIALS AND METHODS

The present study was conducted in10 goat fetuses (5 from group I- CR length up to 20 cm and 5 from group II- CR length 20 cm and above), 5 neonatal goats (group III) and 5 adult goats (group IV*)*. The skin pieces were

obtained from city abattoir and were placed in bag full of ice. At the lab, the skin was cleaned from any attached muscle and hairs using sharp knife. Only 50 gram of skin was acquired for each experiment. After cleaning the skin, it was chopped into fine small pieces (0.3 to 0.5 cm) while taken for fixation. For electron microscopy, small segments of tissues are fixed in a solution containing PBS (Phosphate buffer saline) 0.1M in 2.5% glutaraldehyde at pH=7.2 -7.4, the tissues were fixed for 2 hours (Montes, 1992), followed by postfixation in 1% osmium tetroxide (dissolved in PBS (Phosphate buffer saline) for 2 h. Tissues were dehydrated in an ascending acetone series, 70%, 80%, 90% with three changes of 100% (for 15 minutes each change) and prepared for Transmission Electron Microscopic study by block making and ultra-thin sectioning prepared in ultramicrotome (Ultracut-UCT, Leica) at High Security Animal Disease Laboratory (Jeol JEM-1400), Bhopal.

RESULTS

Advance method carried out to see its magnifying view in TEM (Transmission Electron Microscope) study of skin fibres of goat (*Capra hircus*) in which we find wonderful apparent images of genesis of collagen and its growth in different age groups and explicate the histological and developing stages of collagen fibres clearly.

The study was conducted on 20 goats (*Capra hircus)* of all three age groups. As studies revealed Goat skin contains less hair than the skin of cattle and sheep and the network of collagen fibres is compact and very strong in goat skin. In our observation when examined with the TEM, fibre formation in the sections of group I foetus was not evident .

In group II fetuses the collagen fibrils appeared to arise at the angles of the fibroblast cell (in around 23 to 25 CR length) mainly in deep zone of matrix (Figure1, 2). Initially the fibres appear as bundle of fine, threadlike subunits of about 15 or 20 nm in diameter. It was seen the connective tissue fibrils predominantly of collagenous type extended in different directions [(in the fetuses of 30 to 35 CR length, Figure 3, 4)]. In later stages they form close network in the deep part of the dermis particularly in group III. The rearrangement of collagen bundles during the growth period in *Capra hircus* is documented in Figures 1 to 8 in TEM micrographs are parallel interwoven as in three different ages: fetuses, neonate & adult goat *(Capra hircus)*. The postnatal growth was coupled with a dynamic rearrangement of the tender collagen bundles in the dermal region. They are uncoiled, thickened, and eventually developed a specific pattern of relatively straight bundles (Figure 5, 6). The TEM images confirmed its precise arrangement by showing prominent and strikingly apparent arrangement in neonatal group. Group IV, showing distribution of dense collagen bundles found in rigorously scattered and slack slender groups (Figure 7, 8) running parallel to the epidermis. In this group samples the variation is associated with a loss of fibrous tissue, slower rate of cellular renewal, and a reduced vascular and glandular network. .In most tissues like skin and muscles Collagen are important for strength. Collagen fasciculi are notable for their roles in aging.

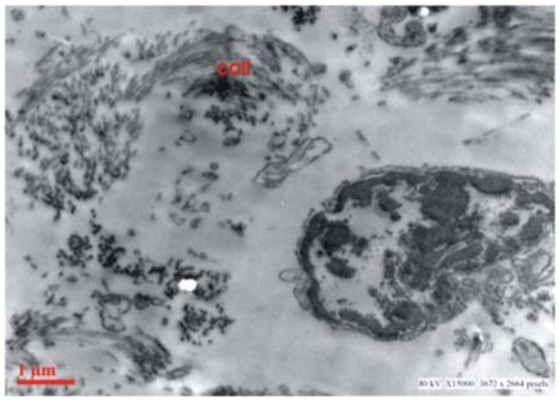

Fig 1: Electron micrograph – cross section of skin of fetal goat (23 CR length, group II), ventral region

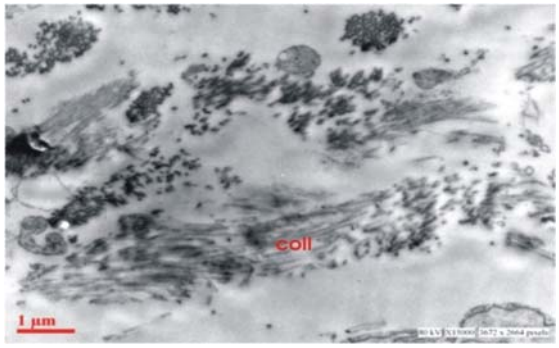

Fig 2: Electron micrograph – cross section of skin of fetal goat (23 CR length, group II), thigh region. Bar: 1 µm

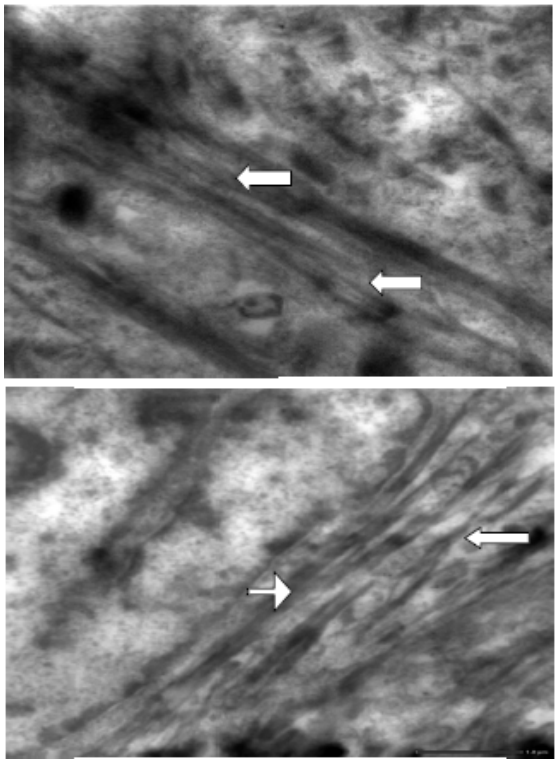

Fig 3 & 4: Electron micrograph – cross section of skin of fetal goat (35 CR length, group II), dorsal region. Bar: (A) 1 µm; (B) 1 µm.

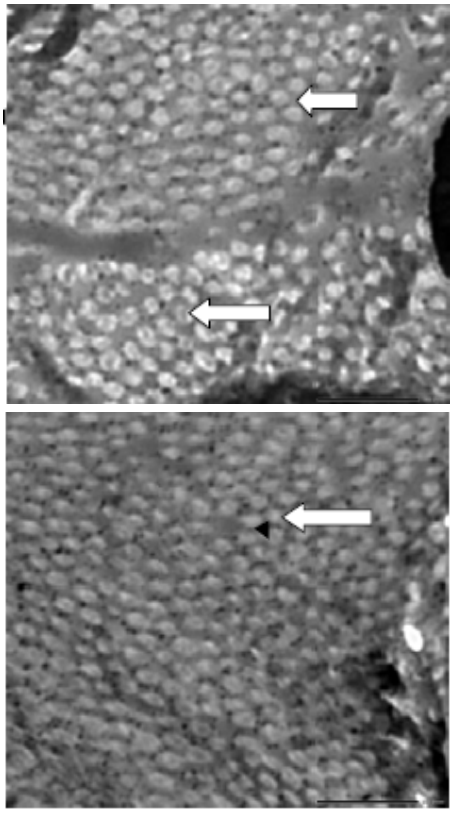

Fig. 5 & 6: Electron micrograph – cross section of skin of neonate goat, dorsal region. Bar: (A) 500 nm; (B) 500 nm.

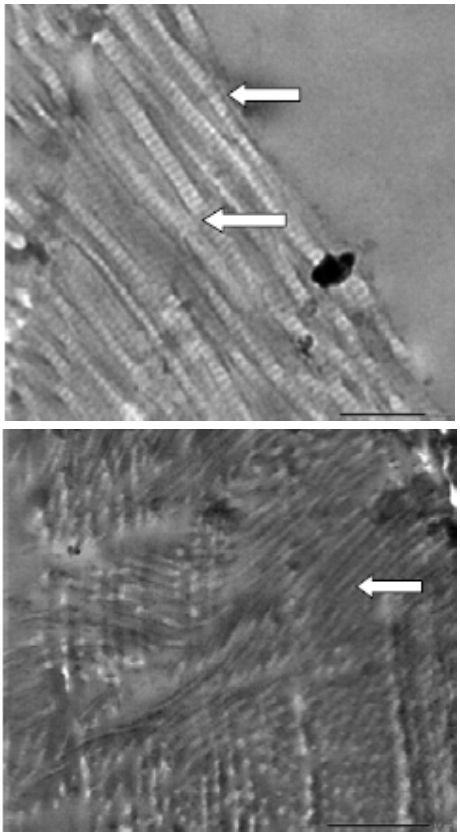

Fig. 7 & 8: Electron micrograph – cross section of skin of Adult goat, dorsal region. Bar: (A) 500 nm; (B) 1 µm

DISCUSSION

The present study indicates that periodically grown up fibrils appeared in a specific developing stage, showing again a specific growth phase and finally it takes a form of rigorously scattered and slack slender groups. Shuhei *et al.,* (1989) studied in TEM and SEM techniques, the rearrangement of collagen bundles in pig skin. As notice in his research work the collagen bundles found arranged in a lattice pattern of relatively straight bundle.

In summarizing our methods of finding the arrangement of the collagen component of the dermis, it is obvious that a dense and massive three dimensional meshwork of fibres and fibre bundles dominates the bulk of this part of the skin leaving little space for other tissue components. Meyer *et al*., (1982) have shown that a close interwoven pattern of elastic and collagen fibres exists in the skin of the pig. They demonstrate that from the structural point of view, the mechanical properties of the dermis of the pig seem to depend largely on the rather rigid and stable network of its collagen component. Buehler (2006) stated Collagen as a protein material with superior mechanical properties. It consists of collagen fibrils composed of a staggered array of ultra-long tropocollagen (TC) molecules. Comparing the collagen fibre arrangement in the dermis of the wild boar with those in the domestic breeds, only the wild pig showed numerous large fibre bundles penetrating into the deep zone of the dermis and into the sub cutis. The comparison of the different body regions clearly showed a relatively lower collagen content in the abdominal region of all animals investigated, especially in the papillary layer and the mid zone of the dermis. This is in agreement with the observation that this body region is normally characterized by a higher content of elastic fibres (Meyer *et al*., 1982).

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