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THE ROLE OF COLLAGEN FIBERS IN WOUND REPAIR PROCESS (SUBJECT REVIEW)

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Abstract:
Collagen defines as most abundant protein in animals' extracellular matrix. There are approximately 27 distinct forms of collagen that have been identified and defined. CF are the most basic structural elements of the extracellular matrix (ECM) in vertebrates, and they serve to: (1) the energy that called store elastic through muscle tissue deformation, (2) transmits energy preserved into the movement of joint, and (3) transport excess energy from the joint back to the appended muscles for dissipation. Collagen, a fundamental constituent of extracellular matrix, plays an important function in wound healing regulation, whether in its native fibrillar form or as soluble constituents in wound environment. As a result, the importance of collagen structure, kinds, and roles in the wound healing process were examined in this study..

Keywords Collagen; wound repair; healing process**.**

INTRODUCTION

Collagen fibers are the primary elements of extracellular matrix, which are tissues outside of the cell (ECMs). Surface and internal linings of the human body, connections in musculoskeletal and oral tissues, walls of conduits, and holding structures of the cardiovascular system and gastrointestinal tract are all made up of ECMs. They also make up the parenchyma, which serves as the organs' structural support [1-2]. Collagen makes up around a quarter of all human proteins. Its name alludes to a group of collagen proteins that differ in terms of their characteristics, location, molecular structure, and spatial arrangement. Collagen is a very diverse protein. Distinct genes code for different fiber chains, which are biosynthesized in various organs. Individual collagen types have distinct characteristics due to changes in post-translational modifications. Collagen is involved in the processes of cell adhesion, development, and differentiation, as well as the healing process, tissue growth, and regeneration. Collagen's fibers have a unique structure that allows it to perform these activities. The beneficial properties of collagen are provided by this spatial structure, known as a superhelix, which provides very high mechanical strength [3-7]. Type I collagen makes up more than 90% of proteins type collagen in body [8]. However, as of 2011, 28 different forms of human collagen had been found, defined, and classified into different categories based on the structures they make. At least one triple helix can be found in each type [9]. Collagen has a wide range of functions, as seen by the number of kinds [10].

STRUCTURE

Tropocollagen is the structural unit of fibril-forming collagens (fig: 1). It's a 300-nanometer-long protein with a 1.5-nanometer diameter. Tropocollagen is made up of three polypeptide chains, each with 1050 amino acids and a distinctive lefthanded helix, which are twisted together to form a right-handed triple helix. The presence of a repeating triplet of glycine and two additional amino acids, one of which is usually proline or hydroxyproline, is a distinguishing feature of collagen molecules. Hydrogen bonding between polypeptide chains is aided by hydroxyproline. The Gly-Pro-Hyp tripeptide sequence, which forms a helix, is known to be the most stable in collagen. Non-triple helical configurations are frequently found at the end of collagen molecules and have a role in covalent intermolecular cross-linking [11-15]. The interaction between the polypeptides that make up the collagen molecule is what gives it its structure. Various forms of collagen have different amino acid compositions and amounts in polypeptide chains. They do, however, share some structural similarities. There are six main types of subunits, each of which is made up of three identical (homotrimer) or three different (heterotrimer) chains, or a combination of the same two and one different chain. The collagen molecule is made up of more than just helical segments; some forms of collagen also have non-helical domains [3, 5]. Repeatable amino acid sequences are found in collagen-forming polypeptide chains, with proline being the most prevalent and Gly-Pro-Hyp being the second most common (Fig: 2).

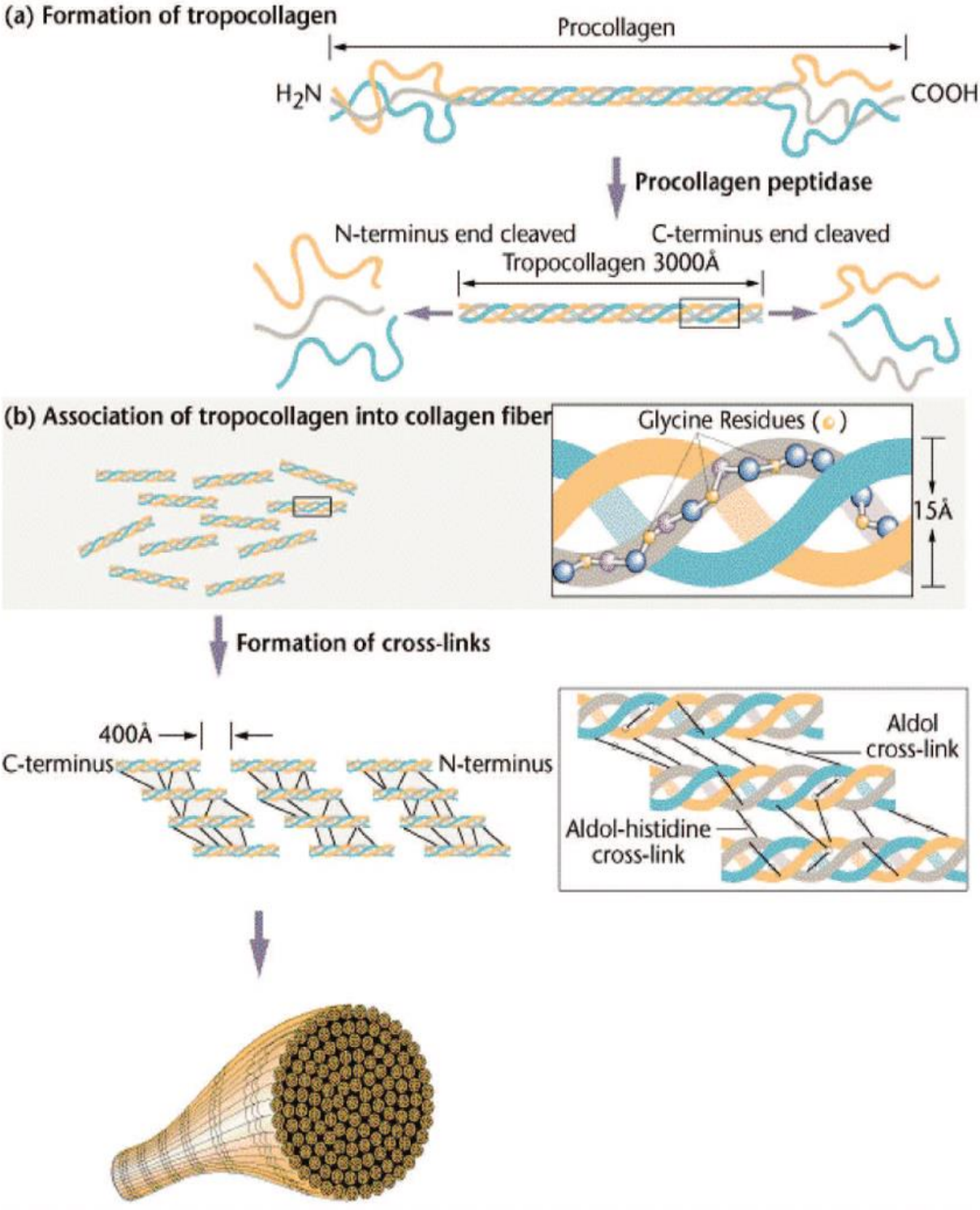

Figure (1): tropocollagen structure [16].

COLLAGENS IN EPIDERMIS AND WOUNDS

Collagens are protein discovered in the human body. Collagens are generated and changed into complex morphologies by cells such as fibroblasts in the healing wound [17–21]. Collagen type, quantity, and organization were change when a wound heals, determining the tensile strength of the recovered skin. Collagen III is the initial type of collagen produced during tissue regeneration, although it is shortly replaced by collagen I, the most prevalent

type of skin collagen. The lysyl oxidase enzyme-induced covalent cross-linking enhances the initial random deposition of collagen during granulation tissue development. During this phase, Collagen forms complicated structures that are reoriented to restore tensile strength. After a wound is closed, collagen remodeling continues for months, and the repaired tissue's tensile strength improves to around 80%–85% of that of normal tissue if all processes go well [22]. The fibrillar collagens types I, III, and V, as well as fibril-associated collagens types XII, XIV, XVI, and VI, are the most frequent in the skin. Skin basement membrane contains non-fibrillar collagens type IV and XVIII [23-24].

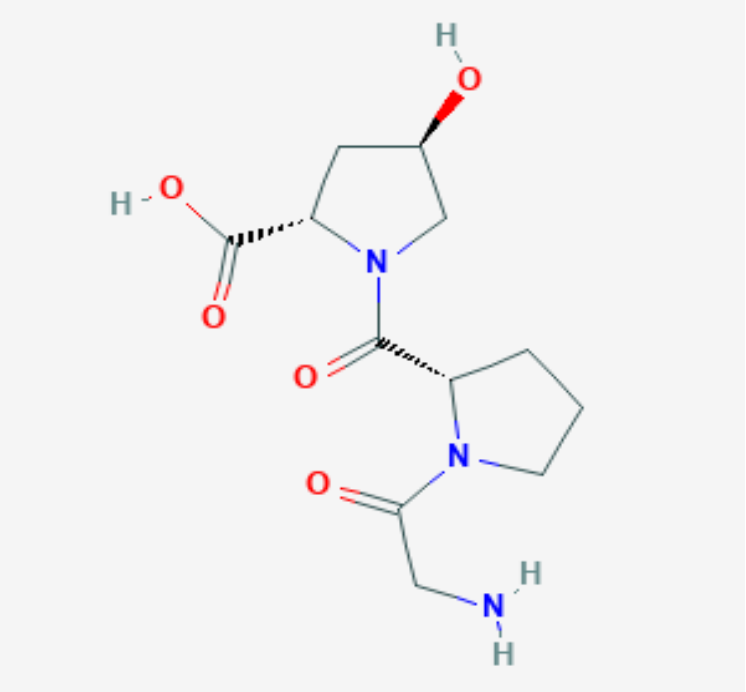

Figure (2): The structural formula of Gly-Pro-Hyp amino acid sequence [16].

WOUND HEALING

Different forms of wounds, including as type called ulcers and the type called burns, can make a big difference in a patient's quality of life, Pressure ulcers, diabetic foot ulcers, and venous leg ulcers are examples of persistent sores. Long-term pressure on the skin causes damage to the skin and underlying tissue, which is known as a pressure ulcer. The ulcers of diabetic foot are a common consequence in diabetics with poorly controlled diabetes. Venous leg ulcers are painful ulcers that develop in the legs as a result of poor circulation of blood in the limbs. Chronic wounds can cause significant morbidity and have a negative impact on one's quality of life. Because of a hyperactive and protracted inflammatory response, increased protease levels, and insufficient ECM, chronic wounds may not respond to standard therapy [25-26]. The mechanism of injury will determine whether the wound is shallow with the dermis intact or deep with the dermis involved [27-28]. In both superficial and deep wounds, the extracellular matrix (ECM) is destroyed and unable to sustain healing, necessitating the use of pre-planned treatment strategies to compensate for or restore ECM functions [29]. A moist wound healing environment is essential for promoting tissue regeneration and preventing eschar development, since it stimulates growth factors, fibroblasts, keratinocytes, as well as the inflammatory response and phagocyte activation [30-31]. Numerous studies show that collagen-based products improve the healing process in chronic or acute cutaneous wounds of various etiologies by creating a stable and moist healing environment. The wound healing process is accelerated, and the number of applications required is reduced, lowering the risk of wound dehiscence and local symptoms of inflammation [32-33]. To increase wound contraction, local fibroblasts respond to PDGF by generating collagen and converting into myofibroblasts. Endothelial cells generate vascular endothelial growth factor (VEGF) and basis fibroblast growth factor (bFGF) to increase blood vessel ingrowth, and fibroblasts release keratinocyte-derived growth factor (KGF) that encourages process called epithelialization from the cells called keratinocytes [34]. The ability to stop continuing collagen formation is a characteristic of normal wound healing physiology, with maximum deposition occurring at around 21 days. The conversion process of type III collagen to type I collagen is the signature process [35]. After approximately 30 days, equilibrium between type I and type III develops, and strength happens after approximately 1.5 to 2 months, After 6 weeks, the usual prescription of activity limitation is issued.

CONCLUSIONS

Collagen is the most prevalent protein in body, and it serves a variety of purposes. Collagen deficiency or loss can lead to skin aging and other illnesses. The importance of collagen in many biological activities related to healing of wound is discussed in this paper.

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