Chapter 1

INTRODUCTION
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“Surgery may leave an impression on your life.... But it should not leave a scar on your body”

- Anonymous

The mechanical qualities of skin provide a unique arrangement of strength and elasticity. These functional qualities are achieved due to the predominant presence of collagen fiber arrangement and to a minor extent by the presence of elastin of elastic fiber and extracellular matrices in the underlying dermis (Holbrook et al., 1982; Peacock et al., 1984).

The dermis of the skin lies subjacent to epidermis. It has two parts that are accountable for sustaining the epidermis. The papillary layer of the dermis is a thin sheet located just below the epidermis. It contains capillaries and a small number of collagen and elastic fibers. The reticular layer of dermis lies deep to it, which contains larger bundles of collagen fibers that usually run parallel to surface of the skin and elastic fibers.

One of the problems identified during the process of wound healing in a clinical setup, is the appearance of scar, along with complications like stretching and hypertrophy. Appearance of scar varies from region to region and from one direction to another. Scar over back and shoulder joint often stretches or develops hypertrophy. The scar in one direction (e.g. horizontal scar over forehead) settles very well with acceptable scarring, but in the same region, if the scar is in another
direction (i.e. vertical scar over forehead) may form unacceptable scarring, due to stretching or hypertrophy.

Appearance of a scar, following wound repair, is a natural process. Intercomplimentary functions or nature of collagen and elastic fibers play a key role in the process of wound healing and subsequent consequences resulting in the formation of the scar. The scar tissue resulting from the process of wound healing have similar type of collagen as in normal skin but with the deviated pattern of arrangement and distribution from the normal (Sherratt, 2010). Studies also proved the role of elastic fibers in the process of improvement of scar appearance along with better wound healing outcomes by using elastin based dermal substitutes (Rnjak et al., 2011).

Since decades, a well-known direction for making incisions to obtain an aesthetic scar has been Langer’s line or cleavage line. Alongside, there have been many other concepts of lines on the skin that have been put forward and made the concept of Langer’s line debatable. Albert Borges pursued an intense study about the lines of skin tension and comprehended with seven best known skin tension lines. According to him, a single best choice of line is still questionable to fulfill complete satisfaction of wound healing (Borges, 1984). Though the merits and demerits of Langer’s line are subjective among the surgeons, its concept has still retained popularity in the field of surgery as a gold standard method. The fact is believed to be pattern of arrangement of dermal collagen in a particular direction.

Plastic surgeons on other hand, in their personal experience and observations in the clinical set up, are still in dilemma about the speckled behavior of a scar, even
after the incisions had been made on the skin in accordance to the standard lines of choice. Even with the varied quantity and asymmetric content of dermal collagen and elastic fibers in different orientations of skin plane affecting the formation of scar remaining a possibility, we could not find any study related to the quantification of collagen and elastic fibers.

A quantitative study on morphometric analysis (using computerized digital image analysis) of dermal collagen in normal human skin reported that there was a significant correlation between the percentage of collagen and its concentration when analyzed biochemically (Branchet et al., 1991). Similarly, the morphometric analysis of elastic fibers performed by analyzing the total area occupied by the fibers per unit skin in normal human skin showed no significant variation with age or gender (Francis et al., 1990).

In our literature search, we did not come across any data in our literature search on histomorphometric (quantitative fraction) analysis of dermal collagen and elastic fibers in different regions of the body in two different directions (horizontal and vertical directions) of skin sections. Similarly, reports on the pattern of association (correlation pattern) between dermal collagen and elastic fiber content and their proportionate changes (ratio analysis) across two different directions of skin plane are also not available in our literature survey.
Therefore, the current research project was undertaken to assess the unbalanced allocation of dermal collagen and elastic fibers in two different directions (horizontal and vertical directions) of skin samples collected from major regions of the human cadavers by simple and reliable method of image analysis technique.

Quantification of dermal collagen and elastic fibers using image analysis is reported to be accurate and comparable to the results obtained using polarized light technique (van-Zuijilen et al., 2002). The percentage area occupied by the tissue structures as demonstrated by biological stains can be measured by image analysis using TissueQuant software and its accuracy and reliability has been reported in previous studies (Chakravarthy et al., 2009; Sreenivasulu et al., 2011; Keerthana et al 2012; Prabhu et al 2014). With the similar principle of action of TissueQuant, quantitative fraction analysis of dermal collagen and elastic fibers can also be achieved by image analysis by applying special histological stain (Verhoeff-van Gieson) method to the skin samples. Based on the above said, an attempt to use ‘TissueQuant’ in our study was done which provided satisfactory results.