The Relationship Between Increased Mechanical Tension and Scar Cosmesis After Total Knee Arthroplasty

William Le Clercq BA, Audrey Ulfers BA, Jack Grace BS, Dr. Felmont Eaves MD, Dr. Christopher Haas MD, Dr. Vinod Dasa MD
1) LSUHSC-NO School of Medicine, 2) LSUHSC-NO Department of Orthopaedic Surgery, 3. LSUHSC-NO Department of Dermatology

Introduction

- The methods and techniques for performing a total knee arthroplasty (TKA) have drastically improved since it was first implemented into treating patients with advanced knee osteoarthritis in 1968. Through years of collaboration and practice, the reliability of the procedure has become rudimentary for enhancing patient's quality of life by providing pain relief and enhancing mobility and range of motion due to local swelling and inflammation. While the procedure itself has become standardized, more research is needed to understand factors influence the dermatologic outcomes of the operation. This aesthetic aspect of the closure and healing process is important for patient satisfaction, particularly for younger patients. Given the suggested link between obesity and worse scar cosmesis, our study aims to determine if this relationship is mediated by increased mechanical tension in high-stress anatomical sites.

Methods

- Prospective study of approximately 30-40 patients presenting at 2 weeks, 3 months, and 6 months post-TKA.
- Primary Outcome: Scar width will be examined as a function of mechanical factors: soft tissue density, thigh circumference, and BMI. Measurements of scar width will be taken at the level of the patella as well as proximal and distal to the joint line.
- We will use a standardized protocol for photographing patients, specifically capturing images of the knee extended and flexed.
- Results will be analyzed using repeated measures ANCOVA to control outlying variables

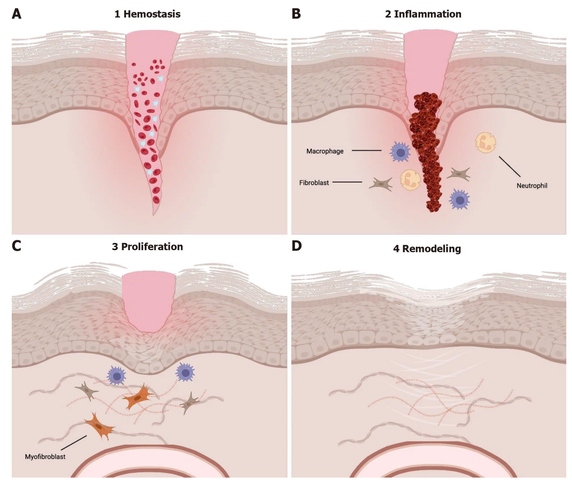

Figure 1: This graphic represents the four phases of wound healing and subsequent scar formation with the first phase being hemostasis followed by inflammation, proliferation, and remodeling. [3]

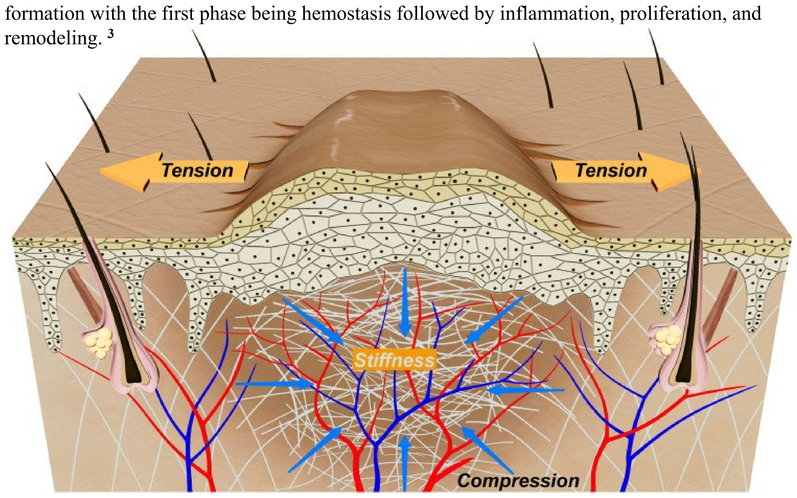

Figure 2: This image is a graphic representation showing how high tension at specific wound sites has a meaningful impact as it pertains to pathological scarring.[2] Mechanical tension on skin directly stimulates fibroblast proliferation and excessive collagen synthesis, driving keloid and hypertrophic scar formation. [1,2]

Anticipated Results

- We hypothesize that patients with higher soft tissue density at the knee, thigh circumference, and BMI will demonstrate a wider scar, as well as worse scar cosmesis after Total Knee Arthroplasty.
- Higher soft tissue density at the level of the knee as well as the distal thigh increases the likelihood of having a wider scar due to increased mechanical tension on the skin. [1,2,6]
- Similarly, higher thigh circumference as well as increased BMI will likely have a positive correlation with high soft tissue density at the knee and thus would likely lead to a wider scar and worse cosmesis.

Limitations

- The eventual sample size of this project will be one that yields significant power but will likely lack generalizability on a large scale.
- Not all the patients included in this study are going to be the same age, which will have an impact on the speed and quality in which a patient's scar heals.
- Loss to follow up from any of the patients included in this study at 2 weeks, 3 months, or 6 months will have a significant impact on results.
- Even with a standardized protocol, due to multiple medical students being involved, small variations and inconsistencies may arise when taking pictures as it pertains to distance and orientation and camera consistency.

What We Hope to Accomplish

- We hope that this project will be able to serve as a resource for patients who are contemplating, or potentially worried about, the cosmetic aspects of a TKA. Whether our hypothesis of having a larger thigh circumference and BMI demonstrating a wider scar is shown in our study will be crucial for patients and physicians in determining if optimizing a patient's weight before surgery would have a significant impact scarring outcomes.
- A similar goal is to help patients create realistic expectations about their eventual scar while considering TKA as an option for treatment.
- As previously mentioned, one limitation of our study is a smaller sample size that lacks generalizability, so we aim to achieve results that are able to be reproduced on a larger scale incorporating many different subpopulations of patients.

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