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EVALUATION OF MECHANICAL BIOCOMPATIBILITY OF COG THREADS FOR PROLAPSE REPAIR

N. M. Ferreira [1], M. E. T. Silva [2], M.P.L. Parente [1], A. A. Fernandes [1]

[1]LAETA-INEGI, Faculty of Engineering, University of Porto, Portugal,

[2]LAETA-INEGI, Portugal,

nmferreira@fe.up.pt, mesilva@inegi.up.pt, mparente@fe.up.pt, aaf@fe.up.pt

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1 INTRODUCTION

Pelvic Organ Prolapse (POP) is a common condition that can significantly impact the quality of life of women resulting from defects in the pelvic structures [1]. The incidence of genital prolapse has been increasing annually although traditional mesh implants are frequently used, they have certain limitations[2], leading to a search for innovative treatments. As a result, there is a growing interest in innovative treatments to address this issue and improve patient outcomes. The focus of our study is to evaluate the efficacy of using cog threads, commonly employed in facial aesthetics, for fortifying the vaginal wall and treating POP.

2 METHODS

The application of Finite element analysis (FEA) to this research allows us to personalize and select suitable POP correction techniques and study the effect of alternative reinforcement techniques, helping to analyze the areas experiencing higher stresses and strains.

The 3D computational model of the vagina will be used to simulate defect repair using cog threads. By utilizing different properties of the vaginal wall (such as early-stage prolapsed tissue), we were able to simulate various repair conditions. This included reinforcing the wall with different numbers of threads and using different thread geometries such as thread diameter and cog type, as illustrated in Figure 1. The angle of thread insertion was determined based on the geometry of the vaginal wall. In the numerical simulations, one and two cog threads were inserted. The threads we will use in our investigation are commercially available 360° 4D barb threads (PCL-19G-100) made of polycaprolactone (PCL).

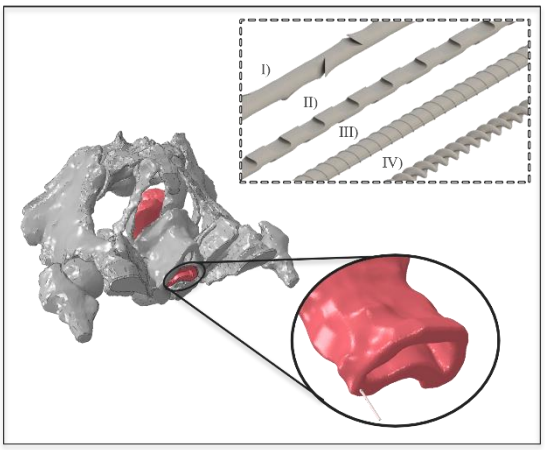

Figure 1 – Pelvic cavity with vaginal wall reinforcement using different types of threads: I) cog thread, II) moulding cog thread, III) rebar, and IV) tornado thread.

3 RESULTS

Preliminary research findings indicate that cog threads offer immediate reinforcement to the vaginal wall while maintaining its natural flexibility. This study is still in progress, so only initial results are available. As shown in Figure 2A, when pressure is exerted on the vaginal canal, the highest stress is concentrated at the notch of the cog thread. In Figure 2B, there is a comparison of stress distribution between an unreinforced vaginal canal and one reinforced with a cog thread. In this case, the cog was omitted to enable a comparison of the stresses induced in the tissue.

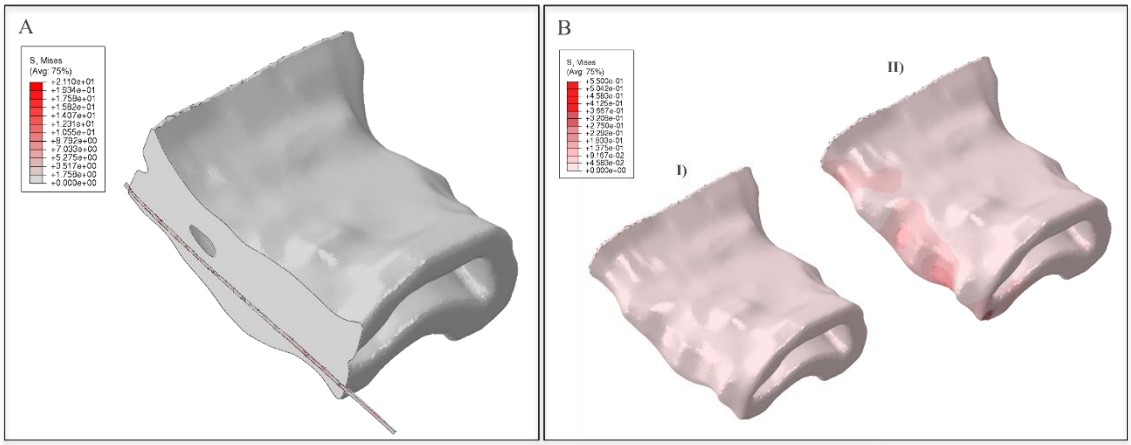

Figure 2 – A) Cog thread reinforcement stress results; B) Stress distribution comparison: I) vaginal wall without cog thread; II) with cog thread.

4 DISCUSSION

Indeed, the vaginal canal is reinforced when cog threads are inserted. This research focuses on refining cog thread designs and exploring their potential in treating more intricate POP models. This technique offers some advantages over conventional meshes, including transvaginal access with local anesthesia, and personalization through variables such as the number of injected threads, choice of material, and type of thread. According to the literature, the introduction of threads triggers the body's natural healing response, leading to enhanced collagen production and increased elastin volume around the threads and cogs [3]. These reactions could potentially have a further beneficial effect on the properties of the vaginal wall, making them a promising solution for addressing the limitations of synthetic meshes. We hypothesize that this innovative technique will contribute to preventing the progression of prolapse, offering an alternative to major surgeries, and mitigating graft-related complications.

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