Investigation of Suture Materials on Meniscal repair in a Rabbit Medial Meniscus Longitudinal Tear Model

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INTRODUCTION: Meniscal preservation is essential for maintaining knee joint biomechanics and preventing the development of osteoarthritis following injury. Meniscal repair is increasingly favored over meniscectomy, particularly in young and active patients. However, the success of meniscal repair largely depends on biological healing, which may be influenced by the type of suture material used [1]. Non-absorbable sutures may provide greater mechanical stability, however, potentially induce chronic inflammation. Moreover, high-strength sutures are often utilized for their ease of handling and ability to stabilize repaired site, although they may cause tissue damage due to their physical properties. In contrast, absorbable sutures are thought to reduce long-term tissue irritation. Despite the widespread clinical use of various sutures, there remains limited experimental evidence directly comparing their effects on healing and tissue damage. Therefore, the purpose of this study was to evaluate the impact of different suture materials on meniscal healing and tissue damage using a rabbit medial meniscus longitudinal tear repair model.

METHODS: Ten Japanese white rabbits were used, and longitudinal tears, 5mm in length, were created in the medial meniscus of both knees [2]. Four groups were established: (1) absorbable suture group using polydioxanone sutures, (2) non-absorbable group using 4-0 nylon sutures, (3) high-strength suture group using high-molecular-weight polyethylene sutures, and (4) control group (no repair) (n=4 knees in each group). At 12 weeks postoperatively, the menisci were harvested and histologically evaluated using hematoxylin eosin and safranin-O/fast green staining. The meniscal healing status was further evaluated using the Modified Miguel's scoring system [3].

RESULTS: In the control group, no healing of the tear site was observed (**Figure 1A**) and the defects remained clearly demarcated (mean score 0.25). The absorbable suture group demonstrated preservation of gross meniscal morphology and continuity of the repaired site on histological examination (**Figure 1B**) (mean score 2.5). Semi-quantitative scores in this group were significantly higher compared with all other groups ($p < 0.05$). The non-absorbable suture groups showed moderate repair (**Figure 1C**) (mean score 1.5). In the high-strength suture group, many specimens exhibited tissue damage and demonstrated poor healing (Figure 2).

DISCUSSION: This study demonstrates that absorbable sutures promote superior histological healing compared with non-absorbable sutures in a rabbit meniscal repair model. Non-absorbable sutures provided partial repair but were associated with incomplete healing, while high-strength sutures caused tissue damage and poor healing outcomes.

SIGNIFICANCE/CLINICAL RELEVANCE: Absorbable sutures may provide better meniscal healing and reduce tissue damage compared with non-absorbable sutures, particularly high-strength suture, supporting their potential benefit in clinical meniscal repair.

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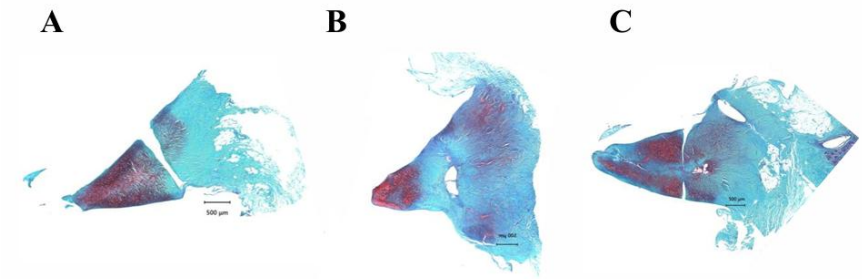

Figure1. Representative images of safranin-o/fast green staining. (A) control group, (B) absorbable suture group, and (C) non-absorbable suture group.

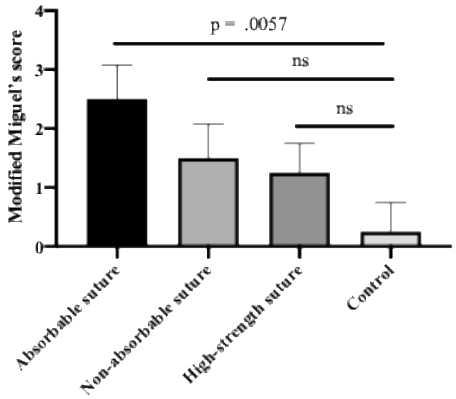

Figure2. Modified Miguel's score