

Regarding “Repair Augmentation of Unstable, Complete Vertical Meniscal Tears With Bone Marrow Venting Procedure: A Prospective, Randomized, Double-Blind, Parallel-Group, Placebo-Controlled Study”



We read with great interest the review “Repair Augmentation of Unstable, Complete Vertical Meniscal Tears With Bone Marrow Venting Procedure: A Prospective, Randomized, Double-Blind, Parallel-Group, Placebo-Controlled Study” by Kaminski et al.¹ We appreciate the authors for their research and summary of this simple and convenient technique, which has been widely used by quite a few sports medicine surgeons to improve the meniscal healing rate during meniscal repair. However, we have some concerns regarding the rationale for bone marrow elements on meniscus repair.

Meniscal tears repaired in conjunction with anterior cruciate ligament (ACL) reconstruction have demonstrated improved healing rates when compared with those repaired in isolation.²⁻⁴ In view of the reasons for this difference, Scott et al.⁵ put forward the viewpoint that the extensive hemarthrosis and secondary generalized synovitis that occur after ligament reconstruction using arthrotomy may promote healing in some ways. Freedman et al.⁶ stated that the improved rate of healing in meniscus repair combined with ACL reconstruction is mainly due to the release of marrow elements into the joint, which has been recognized by a host of scholars. Since then, a series of studies have suggested that blood and bone marrow elements may improve meniscal healing.^{7,8} In this research, the authors conducted a randomized controlled study to compare the effectiveness of bone marrow elements on meniscus repair and indicated that the bone marrow-venting procedure results in a significant improvement in the rate of meniscus healing (100% vs 76%, $P = .0035$). However, because of the requirements of close fitting and sealing between the ligament and bone tunnel during ligament reconstruction, the tunnel is blocked when the graft has been fixed, and the marrow elements can no longer be released into the articular cavity; residual elements in the cavity also may be depleted by arthroscopic irrigation fluid and subsequent intra-articular drains. Although it has been proven that the concentration of a series of growth factors in the ACL reconstruction group was greater than that in the meniscectomy group within 30 minutes after surgery,^{9,10} meniscal healing is a relatively long-term process. With the closure of the bone canal and continuous drainage after surgery, whether the concentration

of growth factors in the joint cavity can be maintained at a high level in the long term to augment healing deserves further study. This makes the relationship between bone marrow elements and increased healing rate of meniscus repair combined ACL reconstruction deserving of further comment. Is biological augmentation not the main cause of the difference in healing rates? Are the re-establishment of knee kinematics and longer rehabilitation the key factors for this difference? Perhaps research on joint kinematics and rehabilitation protocol are of vital significance.

Again, we appreciate the authors for their work on this study, and other researchers also have shown that the bone marrow venting procedure can improve the rate of meniscus healing.^{11,12} However, we hope to discuss with authors the relationship between the improved meniscus healing rate with combined ACL reconstruction and bone marrow elements stimulation.

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References

1. Kaminski R, Kulinski K, Kozar-Kaminska K, Wasko MK, Langner M, Pomianowski S. Repair augmentation of unstable, complete vertical meniscal tears with bone marrow venting procedure: A prospective, randomized, double-blind, parallel-group, placebo-controlled study. *Arthroscopy* 2019;35:1500-1508.e1.
2. Wasserstein D, Dwyer T, Gandhi R, Austin PC, Mahomed N, Ogilvie-Harris D. A matched-cohort population study of reoperation after meniscal repair with and

- without concomitant anterior cruciate ligament reconstruction. *Am J Sports Med* 2013;41:349-355.
3. Cannon WD, Vittori JM. The incidence of healing in arthroscopic meniscal repairs in anterior cruciate ligament-reconstructed knees versus stable knees. *Am J Sports Med* 1992;20:176-181.
 4. Henning CE, Lynch MA, Clark JR. Vascularity for healing of meniscus repairs. *Arthroscopy* 1987;3:13-18.
 5. Scott GA, Jolly BL, Henning CE. Combined posterior incision and arthroscopic intra-articular repair of the meniscus. An examination of factors affecting healing. *J Bone Joint Surg Am* 1986;68:847-861.
 6. Freedman KB, Nho SJ, Cole BJ. Marrow stimulating technique to augment meniscus repair. *Arthroscopy* 2003;19:794-798.
 7. Keller RE, O'Donnell EA, Medina GIS, et al. Biological augmentation of meniscal repair: A systematic review. *Knee Surg Sports Traumatol Arthrosc* 2022;30:1915-1926.
 8. Anz AW, Rodkey WG. Biological enhancement of meniscus repair and replacement. *Sports Med Arthrosc Rev* 2012;20:115-120.
 9. de Girolamo L, Galliera E, Volpi P, et al. Why menisci show higher healing rate when repaired during ACL reconstruction? Growth factors release can be the explanation. *Knee Surg Sports Traumatol Arthrosc* 2015;23:90-96.
 10. Galliera E, De Girolamo L, Randelli P, et al. High articular levels of the angiogenetic factors VEGF and VEGF-receptor 2 as tissue healing biomarkers after single bundle anterior cruciate ligament reconstruction. *J Biol Regul Homeost Agents* 2011;25:85-91.
 11. Dean CS, Chahla J, Matheny LM, Mitchell JJ, LaPrade RF. Outcomes after biologically augmented isolated meniscal repair with marrow venting are comparable with those after meniscal repair with concomitant anterior cruciate ligament reconstruction. *Am J Sports Med* 2017;45:1341-1348.
 12. Ahn JH, Kwon OJ, Nam TS. Arthroscopic repair of horizontal meniscal cleavage tears with marrow-stimulating technique. *Arthroscopy* 2015;31:92-98.

**Author Reply to
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We gratefully thank the Editor for providing us the opportunity to respond to the letter by Wei et al. entitled "Regarding 'Repair Augmentation of Unstable, Complete Vertical Meniscal Tears With Bone Marrow Venting Procedure: A Prospective, Randomized, Double-Blind, Parallel-Group, Placebo-Controlled Study'".

The authors have explained their concerns about the bone marrow venting procedure in the state of meniscus healing. We appreciated their feedback on our study and the opportunity to discuss meniscus healing in reference to anterior cruciate ligament reconstruction and bone marrow element stimulation. Similar observations to ours were made in an independent study by Dean et al.¹ Additionally, at least two randomized clinical trials investigating the influence on meniscal healing of bone marrow venting procedures are ongoing (NCT05053646, NCT04775004).

As the authors said, studies have demonstrated correlation with better meniscus healing after ACL reconstruction compared with ACL-deficient knee.^{2,3} We agree with the authors that reestablishment of proper knee kinematics after ACL reconstruction is correlated with better meniscus healing and lower retear rate. Some studies showed significant differences in anterior shift and external rotation during anterior tibial translation in ACL-deficient knee.^{4,5} We are confident that changes of knee kinematics cause secondary micro-injuries to knee structures (i.e., meniscus)^{6,7} and thus, in our opinion, interrupt healing of the repaired meniscus.

We also agree with the authors that postoperative rehabilitation is an important factor influencing meniscal and cartilage healing. Many experimental studies provided evidence that changes in hydrostatic pressure load increases the production of proteoglycans and glycosaminoglycan⁸ (in articular cartilage), as well as boosts the replication rate in chondrocytes.⁹ On the contrary, variable rehabilitation protocols were studied (no weight bearing and restricted motion vs. full weight bearing and full range of motion), and no significant difference on the rate of successful meniscal healing was noted.^{10,11} Indeed, rehabilitation principles have taken steps forward, but the ideal conditions allowing for the successful healing of a repaired meniscus remains to be fully elucidated.

We suggest that even a short release of growth factors (bone tunnel drilling, bone marrow venting procedures, or a growth factor injections) could provide increased healing potential. In animal models, Koch et al. showed macroscopical and histological enhanced regeneration of teared meniscus by single bone marrow aspirate concentrate injection.¹² Also, Abdel-Hamid et al. made a similar observation.¹³ If a single injection of bone marrow aspirate significantly increases the potential of meniscal healing in animal models, the same mechanism could play a role in human meniscus healing. Girolamo et al. presented increased PDGF concentration after ACL reconstruction in joint fluid 30 min after the end of the surgical procedure.¹⁴ Galliera et al. measured VEGF and VEGFR2 levels after 30 min of arthroscopy in knee joint fluid. They showed significantly higher levels of those factors in the ACL reconstruction group compared to the control group.¹⁵ However, both studies quoted by the authors, have some weak points. The first is joint