The Knee xxx (xxxx) xxx

Contents lists available at ScienceDirect

The Knee

Response to Letter to the Editor on "Anterior cruciate ligament repair versus reconstruction: A kinematic analysis"

Dear Editor

We would like to thank Roy A.G. Hoogeslag MD, Reinoud W. Brouwer, MD, Ph.D., Rianne Huis in 't Veld, Ph.D., and Andrew A. Amis, FREng, DSc, for their interest and observations regarding our recently published study entitled "Anterior cruciate ligament repair versus reconstruction: A kinematic analysis" [1]. We would like to commend their group as we work to advance our knowledge regarding anterior cruciate ligament (ACL) repair techniques.

We agree with the authors that modern arthroscopic ACL repair techniques could be classified as non-augmented (NA), static augmented (SA), and dynamic augmented (DA) as they have different biomechanical characteristics. We share the opinion that in time-zero cadaveric studies, ACL repair can restore anterior tibial translation similar to the ACL-intact knee. However, Hoogeslag R. et al. [2] reported that only DA ACL repairs decrease anterior tibial translation after cyclic loading across the arc of flexion while applying an anterior force to the tibia. They reasoned that the small-diameter femoral and tibial augmentation braids' tunnels were not consistently located at the desired isometric points, resulting in an anisometric NA ACL repair position [3]. Whereas, Di Felice et al. reported minimum gap formation of approximately one millimeter after NA ACL repair with a mean maximum failure load of 243 N following cyclic loading of the knee in a cadaveric study [4]. One potential reason for the significant increase in anterior tibial translation after cycling loading of NA ACL repairs recorded in Hoogeslag et al.'s study was that the ACL was fixed in 20° of flexion, not full extension, which could have elongated the PL fibers. A second reason was the fibers were transected "close" to the attachment of the ACL. In our study, sectioning was performed at the bone interface which facilitated anatomic placement of both anchors under direct visualization (recapitulating a true ACL avulsion). This in turn, improved isometry for each of the bundles, which is more likely to be achieved with an independent bundle fixation technique.

In regard to the preconditioning of the graft, in the ACL reconstruction group, the ACL graft was fixed in full extension with titanium cannulated interference screw 9 × 20 mm (Arthrex Inc.) after cycling the knee 10 times, while applying a distal traction force of 88 N to replicate the clinical scenario and to reproduce previously published studies. Finally, as with all cadaveric studies, our results are limited by the absence of *in vivo* conditions, including: joint compression, dynamic loading, and muscle contraction.

As with most orthopedic procedures, bench findings do not necessarily translate directly to the clinical arena. Early clinical literature on selective ACL repairs using modern day approaches were recently detailed in a systematic review by van der List et al. [5]. This included NA, SA and DA techniques. Although the numbers of DA patients were significantly greater (958) than the NA (74) and SA (69) techniques, the clinical outcomes (all >85%) and failure rates across techniques were roughly similar (NA 10%, SA seven percent, DA 11%). One glaring point of difference did exist however: there was a dramatically higher rate of reoperations and removal of hardware procedures in the DA group (10% reoperations, 29% incidence of hardware removal) *versus* the NA (four percent, 0%, respectively) and the SA (0%, three percent, respectively). These data suggest the spring used to make the DA dynamic could potentially result in a higher reoperation rate.

Finally, we would like to emphasize that more research is needed, including histological and second-look studies to better understand the post-operative healing of ACL repairs. We thank the authors again for their constructive critiques and congratulate them for their essential contributions in such a controversial topic [6].

References

[1] Chahla J, Nelson T, Dallo I, Yalamanchili D, Eberlein S, Limpisvasti O, et al. Anterior cruciate ligament repair versus reconstruction: a kinematic analysis. The Knee.
[2] Hoogeslag RAG, Brouwer RW, Huis In't Veld R, Stephen JM, Amis AA. Dynamic augmentation restores anterior tibial translation in ACL suture repair: a biomechanical comparison of non-, static and dynamic augmentation techniques. Knee Surg Sports Traumatol Arthrosc 2018;26:2986–96.

Please cite this article as: I. Dallo, T. Nelson, D. Yalamanchili, et al.,
Response to Letter to the Editor on "Anterior cruciate ligament repair versus reconstruction: A kin..., The Knee, https://doi.org/10.1016/j.knee.2020.02.006

[3] Hoogeslag RAG, Brouwer RW, Huis In't Veld R, Amis AA. Isometric placement of the augmentation braid is not attained reliably in contemporary ACL suture repair. The Knee 2020;27(1):111–23.
[4] van der List JP, DiFelice GS. Gap formation following primary repair of the anterior cruciate ligament: a biomechanical evaluation. Knee 2017;24:243–9.
[5] van der List JP, Vermeijden HD, Sierevelt IN, DiFelice GS, van Noort A, Kerkhoffs G. Arthroscopic primary repair of proximal anterior cruciate ligament tears seems safe but higher level of evidence is needed: a systematic review and meta-analysis of recent literature. Knee Surg Sports Traumatol Arthrosc 2019.
[6] Hoogeslag RAG, Brouwer RW, Boer BC, de Vries AJ, Huis In't Veld R. Acute anterior cruciate ligament rupture: repair or reconstruction? Two-year results of a randomized controlled clinical trial. Am J Sports Med 2019;47:567–77.

Ignacio Dallo, MD
Unit of Regenerative Therapy and Arthroscopy Surgery, Sanatorio Garay, Santa Fe, Argentina of America

Trevor Nelson
Orthopaedic Biomechanics Laboratory, Cedars-Sinai Medical Center, Los Angeles, CA, United States of America

Dheeraj Yalamanchili, MD
Department of Orthopaedic Surgery, Cedars-Sinai Medical Center, Los Angeles, CA, United States of America
Corresponding author.
E-mail address: Dheeraj.Yalamanchili@cshs.org

Sam Eberlein
Orthopaedic Biomechanics Laboratory, Cedars-Sinai Medical Center, Los Angeles, CA, United States of America

Orr Limpisvasti, MD
Bert Mandelbaum, MD
Cedars-Sinai Kerlan-Jobe Institute, Santa Monica, CA, United States of America

Melodie Metzger, PhD
Orthopaedic Biomechanics Laboratory, Cedars-Sinai Medical Center, Los Angeles, CA, United States of America

Jorge Chahla, MD, PhD
Cedars-Sinai Kerlan-Jobe Institute, Santa Monica, CA, United States of America

Please cite this article as: I. Dallo, T. Nelson, D. Yalamanchili, et al.,
Response to Letter to the Editor on "Anterior cruciate ligament repair versus reconstruction: A kin..., The Knee, https://doi.org/10.1016/j.knee.2020.02.006