



Universiteit  
Leiden  
The Netherlands

## Mapping isometry and length changes in ligament reconstructions of the knee

Kernkamp, W.A.

### Citation

Kernkamp, W. A. (2020, October 14). *Mapping isometry and length changes in ligament reconstructions of the knee*. Retrieved from <https://hdl.handle.net/1887/137727>

Version: Not Applicable (or Unknown)

License: [Leiden University Non-exclusive license](#)

Downloaded from: <https://hdl.handle.net/1887/137727>

**Note:** To cite this publication please use the final published version (if applicable).

Cover Page



Universiteit Leiden



The handle <http://hdl.handle.net/1887/137727> holds various files of this Leiden University dissertation.

**Author:** Kernkamp, W.A.

**Title:** Mapping isometry and length changes in ligament reconstructions of the knee

**Issue Date:** 2020-10-14

## **ACKNOWLEDGEMENTS**

I would like to thank all co-authors as none of the presented works in this thesis would have been possible without their efforts. A special thanks goes to dr. Guoan Li, dr. Tsung-Yuan Tsai, Prof. dr. Rob G.H.H. Nelissen, dr. Ewoud R.A. van Arkel and dr. Samuel K. van de Velde. I would like to thank you for encouraging me to develop my academic potential and pursuing my PhD in orthopaedic biomechanical research.

A very special thanks goes out to my parents, Willem F. Kernkamp and Machteld E. Kernkamp-Vos for always encouraging me to follow my dreams and supporting me in any way possible. Without you this thesis would not have been possible.

I would like to thank Nathan H. Varady and Axel J.T. Jens for the great time in Boston and our fruitful collaborations.

I would like to thank Cong Wang and Changzhou Li and all other lab members in Shanghai for the warm welcome and amazing time.

Finally, I would like to thank my dear Bostonian friends Clemens Köllmann, Jonathan Lans, Rens Bexkens, Bart Lubberts, Nuno Rui Paulino Pereira, Paul Oginik, Kamil Oflazoglu and Nick Hilgersom.

## CURRICULUM VITAE

Willem Alexander Kernkamp was born on April 13<sup>th</sup> 1989, in Madrid, Spain. The first part of his childhood he spent in Madrid and his second part he spent in Boxmeer. He has a one-year older brother, Dirk-Jan, and an eleven-year younger sister, Paula. After graduating from secondary school, he started his medical training at the Leiden University Medical Center, the Netherlands. During medical training, he completed a clinical rotation at the emergency department with dr. Sa'ad Lahri and dr. Hennie Lategan at the Stellenbosch University, Khayelitsha District hospital. Furthermore, he completed clinical rotations at the Orthopaedic Surgery department of the Haaglanden Medical Center with dr. E.R.A. van Arkel and at Deventer Hospital with dr. H.P. van Jonbergen. During his clinical rotations he studied the length changes of the anterolateral ligament and wrote a paper about the anterolateral ligament reconstruction.

After graduating *cum laude* from medical school in 2015, he joined the Bioengineering Laboratory at the Massachusetts General Hospital and Harvard Medical School in Boston, Massachusetts (USA), as a postdoctoral research fellow in 2015. With Prof. dr. G. Li, Prof. Prof. dr. T.Y. Tsai, Prof. dr. R.G.H.H. Nelissen, dr. E.R.A. van Arkel, dr. S.K. van de Velde and in collaboration with dr. R.F. LaPrade (Steadman Philippon Clinic) he initiated the study into the ligament length changes of the knee, as outlined in this thesis. In 2018 he went to Shanghai to continue his work on ligament length changes under the supervision of Prof. dr. T.Y. Tsai at the Shanghai Jiao Tong University, Shanghai. Some of the accolades of his stay in Boston include a 2<sup>nd</sup> place of the O'Donoghue Sports Injury Research Award, and two-time winner of the dr. Eikelaar Award of the Dutch Arthroscopy Association.

At the end of 2018, he returned to the Netherlands to commence his clinical work at Albert Schweitzer Hospital, Dordrecht, under the supervision of dr. P.W. Plaisier. He started his Orthopaedic surgery residency at the 1<sup>st</sup> of January 2020 in the ROGO Leiden under the supervision of Prof. dr. Nelissen and Dr. E.R.A. van Arkel. At the same time, he will continue to further build a long-lasting collaboration between Boston and Shanghai.

## PUBLICATIONS

### Publications related to this thesis

**W.A. Kernkamp**, N.H. Varady, J.S. Li, T.Y. Tsai, P.D. Asnis, E.R.A. van Arkel, R.G.H.H. Nelissen, T.J. Gill, S.K. van de Velde, G. Li: An in-vivo prediction of anisometry and strain in anterior cruciate ligament reconstruction – A combined magnetic resonance and dual fluoroscopic imaging analysis; *Arthroscopy* 2018

**W.A. Kernkamp**, N.H. Varady, J.S. Li, P.D. Asnis, E.R.A. van Arkel, R.G.H.H. Nelissen, S.K. van de Velde, G. Li: The effect of ACL deficiency on the end-to-end distances of the tibiofemoral ACL attachment during in vivo activity; *The Knee* 2018

**W.A. Kernkamp**, A.J.T. Jens, N.H. Varady, E.R.A. van Arkel, R.G.H.H. Nelissen, P.D. Asnis, R.F. LaPrade, S.K. Van de Velde, G. Li: Anatomic is Better than Isometric Posterior Cruciate Ligament Tunnel Placement Based Upon In Vivo Simulation; *Knee Surg Sports Traumatol Arthrosc* 2018

**WA. Kernkamp**, S.K. van de Velde, A. Hosseini, T.Y. Tsai, J.S. Li, E.R.A. van Arkel, G. Li: In vivo anterolateral ligament length change in the healthy knee during functional activities — A combined magnetic resonance and dual fluoroscopic imaging analysis; *Arthroscopy* 2017

**W.A. Kernkamp**, S.K. van de Velde, T.Y. Tsai, E.R.A. van Arkel, P.D. Asnis, R.F. LaPrade, R.G.H.H. Nelissen, B. Zarins, G. Li: An in vivo simulation on isometry of the anterolateral aspect of the healthy knee; *J Bone Joint Surg Am* 2017

**W.A. Kernkamp**, C. Wang, C. Li, H. Hu, E.R.A. van Arkel, R.G.H.H. Nelissen, R.F. LaPrade, S.K. van de Velde, T.Y. Tsai; The Medial Patellofemoral Ligament is a Dynamic and Anisometric Structure – An In vivo Study on Length Changes and Isometry; *Am J Sports Med* 2019

## Other Publications

**W.A. Kernkamp**, S.K. van de Velde, E.W.P. Bakker, E.R.A. van Arkel: Anterolateral extra-articular soft tissue reconstruction in anterolateral rotatory instability of the knee; *Arthrosc Tech* 2015

**W.A. Kernkamp**, W.C. Verra, B.G.C.W. Pijls, H.M.J. van der Linden, R.G.H.H. Nelissen: Conversion from knee arthrodesis to arthroplasty: systematic review; *Int Orthop* 2016

S.K. van de Velde, **W.A. Kernkamp**, A. Hosseini, E.R.A. van Arkel, R.F. LaPrade, G. Li: In vivo length changes of the anterolateral ligament and related extra-articular reconstructions; *Am J Sports Med* 2016

L. Lin, J.S. Li, **W.A. Kernkamp**, A. Hosseini, C. Kim, P. Yin, L. Wang, T.Y. Tsai, G. Li: Postoperative time dependent tibiofemoral articular cartilage contact kinematics during step-up after ACL reconstruction; *J Biomech* 2016

**W.A. Kernkamp**, S.K. van de Velde, G. Li: The anterolateral ligament: a closed chapter?; *Ann Transl Med* 2016

N.H. Varady, **W.A. Kernkamp**, H. Koga, P.D. Asnis, G. Li: The biomechanical effect of tunnel placement on ACL graft forces in double bundle ACL reconstruction; *Int J Med Robot* 2017

G. Li, **W.A. Kernkamp**, H.E. Rubash: In vitro and in vivo kinematics of total knee arthroplasty — A review of the research at the Bioengineering Laboratory of the Massachusetts General Hospital; *Ann Joint* 2016

A. Hosseini, **W.A. Kernkamp**, N.H. Varady, G. Li: Residual Joint Laxity and Increased Cartilage Contact Deformation in ACL Reconstructed Knees; *HMSOJ* 2017

Y. Pin, J.S. Li, **W.A. Kernkamp**, T.Y. Tsai, S.H. Baek, A. Hosseini, L. Lin, P. Tang, G. Li: Analysis of in-vivo articular cartilage contact surface of the knee during a step-up motion; *Clin Biomech* 2017

F.R. van Tol, **W.A. Kernkamp**, R.J.P. van der Wal, S.K. van de Velde, J.W.A. Swen, E.R.A. van Arkel; The occurrence of meniscal and chondral injury in two-stage revision anterior cruciate ligament reconstruction: a consecutive case series; *J Knee Surg* 2018

Z. Rao, C. Zhou, **W.A. Kernkamp**, T.E. Foster, H.S. Bedair, G. Li; In vivo kinematics and ligamentous function of the knee during weight-bearing flexion – implication to femoral condyle motion of total knee arthroplasty; *Knee Surg Sports Traumatol Arthros* 2019

N.H. Varady, A.A. Chandawarkar, **W.A. Kernkamp**, I. Gans; Who Should You Be Following? The Top 100 Social Media Influencers in Orthopaedic Surgery; *World J Orthop*. 2019

C. Huang, H. Tan, **W.A. Kernkamp**, R. Cheng, J. Liang, Z. Zhu, S.H. Baek, L. Wang, T.Y. Tsai; Effect of altered proximal femoral geometry on predicting femoral stem anteversion in patients with developmental dysplasia of the hip; *J Orthop Surg Res.* 2019

C. Huang, H. Tan, **W.A. Kernkamp**, R. Cheng, J. Liang, Z. Zhu, S.H. Baek, L. Wang, T.Y. Tsai; Effect of altered proximal femoral geometry on predicting femoral stem anteversion in patients with developmental dysplasia of the hip; *J Orthop Surg Res.* 2019

M. Bergsma, J.N. Doornberg, A. Borghorst, **W.A. Kernkamp**, R.L. Jaarsma, G.I. Bain; The watershed line of the distal radius: cadaveric and imaging study of anatomical landmarks; *JWS* 2019

Z. Rao, C. Zhou, Q. Zhang, **W.A. Kernkamp**, J. Wang, L. Cheng, T.E. Foster, H.S. Bedair, G. Li; There are isoheight points that measure constant femoral condyle heights along the knee flexion path; *Knee Surg Sports Traumatol Arthrosc* 2020

### **Abstracts, Poster Presentations and Exhibits Presented at Professional Meetings**

S.K. van de Velde, **W.A. Kernkamp**, A. Hosseini, E.R.A. van Arkel, R.F. LaPrade, G. Li: In vivo elongation patterns of the lateral extra-articular structures of the knee in ACL deficiency - ORS; March 2016; Orlando, FL, USA

S.K. van de Velde, **W.A. Kernkamp**, A. Hosseini, E.R.A. van Arkel, R.F. LaPrade, G. Li: In vivo elongation patterns of the lateral extra-articular structures of the knee in ACL deficiency - NVA; April 2016; s'Hertogenbosch, the Netherlands

S.K. van de Velde, **W.A. Kernkamp**, A. Hosseini, E.R.A. van Arkel, R.F. LaPrade, G. Li: In vivo elongation patterns of the lateral extra-articular structures of the knee in ACL deficiency - ESSKA; May 2016; Barcelona, Spain

**W.A. Kernkamp**, S.K. van de Velde, T.Y. Tsai, E.R.A. van Arkel, P.D. Asnis, R.F. LaPrade, R.G.H.H. Nelissen, B. Zarins, G. Li: An in vivo simulation on isometry of the anterolateral aspect of the healthy knee – MGH Clinical Research Day; October 2016; Boston, MA, USA

**W.A. Kernkamp**, S.K. van de Velde, T.Y. Tsai, E.R.A. van Arkel, P.D. Asnis, R.F. LaPrade, R.G.H.H. Nelissen, B. Zarins, G. Li: An in vivo simulation on isometry of the anterolateral aspect of the healthy knee – NVA; February 2017; Rotterdam, The Netherlands

**W.A. Kernkamp**, S.K. van de Velde, T.Y. Tsai, E.R.A. van Arkel, P.D. Asnis, R.F. LaPrade, R.G.H.H. Nelissen, B. Zarins, G. Li: An in vivo simulation on isometry of the anterolateral aspect of the healthy knee – ORS; March 2017; San Diago, CA, USA

N.H. Varady, **W.A. Kernkamp**, J.S. Li, L. Wang, H. Koga, P.D. Asnis, G. Li; Biomechanical effect of PL tunnel positioning in double-bundle reconstruction—A 3D computational study – ORS; March 2017; San Diago, CA, USA

J.S. Li, T.Y. Tsai, **W.A. Kernkamp**, N.H. Varady, D.T. Felson, C.L. Lewis: Articular cartilage contact characteristics during gait in obese individuals – March 2017; San Diago, CA, USA

L. Lin, J.S. Li, **W.A. Kernkamp**, A. Hosseini, C.W. Kim, P. Yin, L. Wang, T.Y. Tsai, P.D. Asnis, T. Gill, G. Li.: Postoperative time dependent tibiofemoral articular cartilage contact kinematics during step-up after ACL reconstruction – March 2017; San Diago, CA, USA

S.H. Baek, J.S. Li, **W.A. Kernkamp**, P.D. Asnis, T.J. Gill, G. Li.: Altered in-vivo patellofemoral kinematics in anterior cruciate ligament deficiency: A comparative study with healthy knees during a step-up activity – ORS; March 2017; San Diago, CA, USA

**W.A. Kernkamp**, S.K. van de Velde, T.Y. Tsai, E.R.A. van Arkel, P.D. Asnis, R.F. LaPrade, R.G.H.H. Nelissen, B. Zarins, G. Li: An in vivo simulation on isometry of the anterolateral aspect of the healthy knee – EFORT; May 2017; Vienna, Austria

**W.A. Kernkamp**, S.K. van de Velde, T.Y. Tsai, E.R.A. van Arkel, P.D. Asnis, R.F. LaPrade, R.G.H.H. Nelissen, B. Zarins, G. Li: An in vivo simulation on isometry of the anterolateral aspect of the healthy knee – ISAKOS; June 2017; Shanghai, China

**W.A. Kernkamp**, A.J.T. Jens, N.H. Varady, J.S. Li, P.D. Asnis, E.R.A. van Arkel, R.G.H.H. Nelissen, S.K. Van de Velde, G. Li; In-vivo Posterior cruciate ligament tunnel positioning and the relationship to graft elongation patterns – ORS; March 2018; New Orleans, LA, USA

J. Wang, **W.A. Kernkamp**, J.S. Li; T.Y. Tsai, G. Li; Mediolateral femoral condyle heights during in vivo weightbearing motion of healthy knees – ORS; March 2018; New Orleans, LA, USA

**W.A. Kernkamp**; PhD Worldwide – NOV; Oktober 2018, Rotterdam, Zuid-Holland, Netherlands

**W.A. Kernkamp**, C. Wang, C. Li, H. Hu, E.R.A. van Arkel, R.G.H.H. Nelissen, R.F. LaPrade, S.K. van de Velde, T.Y. Tsai; The medial patellofemoral ligament is a dynamic and anisometric structure – An in vivo study on length changes and isometry; CSSM; October 2018, Chongqing, China

**W.A. Kernkamp**, C. Wang, C. Li, H. Hu, E.R.A. van Arkel, R.G.H.H. Nelissen, R.F. LaPrade, S.K. van de Velde, T.Y. Tsai; The medial patellofemoral ligament is a dynamic and anisometric structure – An in vivo study on length changes and isometry; COA; November 2018, Xiamen, China

**W.A. Kernkamp**, A.J.T. Jens, N.H. Varady, E.R.A. van Arkel, R.G.H.H. Nelissen, P.D. Asnis, R.F. LaPrade, S.K. Van de Velde, G. Li; In vivo length changes of various tibial and femoral attachments of the posterior cruciate ligament; AAOS; March 2019, Las Vegas, Nevada, USA

**W.A. Kernkamp**, C. Wang; C. Li, E.R.A. van Arkel, R.G.H.H. Nelissen, R.F. LaPrade, S.K. van de Velde, T.Y. Tsai; In-vivo length changes and isometry of the medial patellofemoral ligament during weightbearing motion; ORS; February 2019, Austin, Texas, USA

C. Wang, **W.A. Kernkamp**, C. Li, C. Zhang, T.Y. Tsai; In-vivo medial patellofemoral ligament orientation at the patellar attachment during lunge; ORS; February 2019, Austin, Texas, USA

M. Huang, R. Cheng, J. Zheng, **W.A. Kernkamp**, L. Wang. T.Y. Tsai; The effects of developmental dysplasia of the hip on the pelvic incidence; ORS; February 2019, Austin, Texas, USA

R. Cheng, H. Zhang, J. Zheng, **W.A. Kernkamp**, L. Wang, T.Y. Tsai; Crowe classification cannot reflect the degree of femoral head 3D subluxation in patients with developmental dysplasia of the hip; ORS; February 2019, Austin, Texas, USA

C. Li, **W.A. Kernkamp**, C. Wang, P.Y. Li, Y. Chen, H. Hu, T.Y. Tsai; In-vivo six degrees-of-freedom kinematics of the knee during open and closed kinetic chain exercises; ORS; February 2019, Austin, Texas, USA

Z. Rao, C. Zhou, **W.A. Kernkamp**, H.S. Bedair, T.D. Cha, T.E. Foster, G. Li; Synergistic function of anterior and posterior cruciate ligaments of intact knees during in-vivo lunge motion; ORS; February 2019, Austin, Texas, USA

**W.A. Kernkamp**, C. Wang; C. Li, E.R.A. van Arkel, R.G.H.H. Nelissen, R.F. LaPrade, S.K. van de Velde, T.Y. Tsai; In-vivo length changes and isometry of the medial patellofemoral ligament during weightbearing motion; ISAKOS; May 2019, Cancun, Quintana Roo, Mexico

N.H. Varady, A.A. Chandawarkar, **W.A. Kernkamp**, I. Gans; Who Should You Be Following? The Top 100 Social Media Influencers in Orthopaedic Surgery; ISAKOS; May 2019, Cancun, Quintana Roo, Mexico

N.H. Varady, A.A. Chandawarkar, **W.A. Kernkamp**, I. Gans; Who Should You Be Following? The Top 100 Social Media Influencers in Orthopaedic Surgery; EOA; October 2019, Palm Beach, Florida, USA

N.H. Varady, A.A. Chandawarkar, W.A. Kernkamp, I. Gans; Who should you be following? The top 100 social media influencers in orthopaedic surgery; NEOS; May 2019, Woodstock, Vermont, USA

Z. Rao, C. Zhou, **W.A. Kernkamp**, T. Foster, H. Bedair, G. Li; In Vivo kinematics and ligamentous function of the knee during weight-bearing flexion - An investigation on mid-range flexion of the knee; ORS; Feb 2020; Phoenix, Arizona, USA

Z. Rao, C. Zhou, Q. Zhang, **W.A. Kernkamp**, J. Wang; L. Cheng, T. Foster, H. Bedair, G. Li; Flexion of the knee - implication to gap balancing of total knee arthroplasty; ORS; Feb 2020; Phoenix, Arizona, USA

C. Wang, C. Li, **W.A. Kernkamp**, H. Hu, C.H. Yang, T.Y. Tsai; Effects Of Different Rehabilitation Exercises On In-vivo Elongation Of Anterior Cruciate Ligament Bundles; ORS; Feb 2020, Phoenix, Arizona, USA

