

Genu Arthro

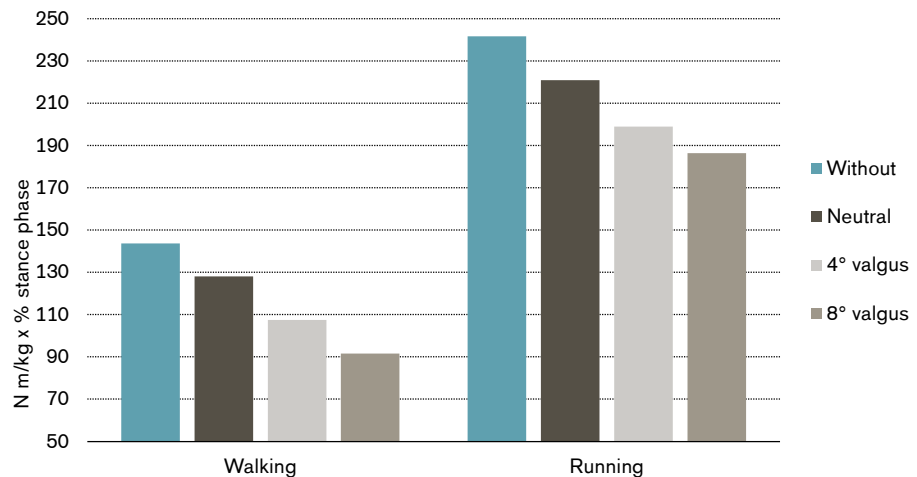
Biomechanics – Gait analysis

Major Findings

With Genu Arthro:

- **Faster walking speed by 7.1%** (Schmalz et al., 2010)
- **Cadence (steps/min) increased by 2.8%** (Schmalz et al., 2010)
- **Genu Arthro raises the first vertical force maximum while walking by 4.8%** (Schmalz et al., 2010)
- **Knee lever arm with Genu Arthro at 20-30% and 70-80% of the stance phase was**
 - 9-12% shorter than without orthosis (20-30% of the stance phase)
 - 19-21% shorter than without orthosis (70-80% of the stance phase)The effect was twice to three times bigger than with the lateral wedge insoles.
- **If a valgus moment is applied to the knee:**
 - External knee adduction moments are reduced up to 21% in walking (compared to wearing no orthosis) and up to 15% (compared to wearing insoles) (Fantini Pagani et al., 2012)
 - Net knee adduction moments are reduced up to 36.3% in walking and up to 23% in running (Fantini Pagani et al., 2010a)
- **Greater valgus adjustments of the orthosis produce greater valgus moments** (Fantini Pagani et al., 2010a)

Reduction of the net peak adduction moments



Fantini Pagani, 2010a.

Clinical Relevance

Osteoarthritis (OA) is characterized by irreversible damage to joint structures, including cartilage, bone, and joint capsule (Felson et al., 2004). Non-pharmacological therapies or mechanical interventions, such as use of knee orthoses and laterally wedged insoles, act on the underlying disease mechanisms to decrease or redistribute the mechanical load in the musculoskeletal system (Pollo et al., 2002).

Knee braces (such as Genu Arthro) are designed to reduce the loading of an affected knee compartment by application of a valgus moment directly to the knee through a three point bending system (Pollo et al., 1998).

Summary

Compared to walking without orthosis, the walking speed as well as the cadence increased significantly by 7.1% or 2.8% (Schmalz et al., 2010), respectively. Fantini Pagani et al. (2010a) reported a significant difference in gait velocity only between the neutral and no orthosis condition.

With respect to the forces occurring during gait, Schmalz et al. (2010) documented an increase in the first vertical force maximum by 4.8%. As opposed to this, Kutzner et al. (2011) recorded a slight, but not significant decrease (up to 3%) in the vertical force with Genu Arthro (8° valgus). Furthermore, a reduction of the medial force by 7% was measured in this condition.

The knee lever arm with Genu Arthro at 20-30% and 70-80% of the gait cycle was 9-12% and 19-21% shorter than without orthosis. Compared to lateral wedge insoles, the effect was two to three times bigger (Fantini Pagani et al., 2012).

With a valgus moment applied to the knee, the external knee adduction moments are reduced by up to 21% in walking (compared to wearing no orthosis) and by up to 15% (compared to wearing insoles) (Fantini Pagani et al., 2012). Two other studies of Fantini Pagani et al. support these results for walking, with increases by up to 18.6% (2010a) and 16.7% (2010b), respectively.

Also, the net knee adduction moments are reduced by up to 36.6% in walking and by up to 23% in running (Fantini Pagani et al., 2010a). These results are again supported by the two other studies of Fantini Pagani et al. (2010b & 2012).

All results of Fantini Pagani et al. (2010a, 2010b, 2012) showed, that greater valgus adjustments of the orthosis produce greater valgus moments.

References of summarized studies

Fantini Pagani CH, Potthast W, Brüggemann G-P (2010a). The effect of valgus bracing on the knee adduction moment during gait and running in male subjects with varus alignment. *Clinical Biomechanics*; 25:70-76.

Fantini Pagani CH, Böhle C, Potthast W, Brüggemann G-P (2010b). Short-Term Effects of a Dedicated Knee Orthosis on Knee Adduction Moment, Pain, and Function in Patients With Osteoarthritis. *Arch Phys Med Rehabil*; 91:1936-41.

Fantini Pagani CH, Hinrichs M, Brüggemann G-P (2012). Kinetic and Kinematic Changes with the Use of Valgus Knee Brace and Lateral Wedge Insoles in Patients with Medial Knee Osteoarthritis. *Journal of Orthopaedic Research*; 30:1125-1132.

Kutzner I, Kuther S, Heinlein B, Dymke J, Bender A, Halder AM, Bergmann G (2011). The effect of valgus braces on medial compartment load of the knee joint– in vivo load measurements in three subjects. *Journal of Biomechanics*; 44: 1354–1360.

Schmalz T, Knopf E, Drewitz H, Blumentritt S (2010). Analysis of biomechanical effectiveness of valgus-inducing knee brace for osteoarthritis of knee. *JRRD*; 47 (5): 419-29

Other References

Felson DT (2004). Risk factors for osteoarthritis. *Clin Orthop Relat Res* 427S:16–21.

Pollo FE (1998). Bracing and heel wedging for unicompartmental osteoarthritis of the knee. *Am J Knee Surg* 11: 47–50.

Pollo FE, Otis JC, Backus MA, et al. (2002). Reduction of medial compartment loads with valgus bracing of the osteoarthritic knee. *Am J Sports Med* 30:414–421.

© 2014, Otto Bock HealthCare Products GmbH ("Otto Bock"), All Rights Reserved. This article contains copyrighted material. Wherever possible we give full recognition to the authors. We believe this constitutes a 'fair use' of any such copyrighted material according to Title 17 U.S.C. Section 107 of US Copyright Law. If you wish to use copyrighted material from this site for purposes of your own that go beyond 'fair use', you must obtain permission from the copyright owner. All trademarks, copyrights, or other intellectual property used or referenced herein are the property of their respective owners. The information presented here is in summary form only and intended to provide broad knowledge of products offered. You should consult your physician before purchasing any product(s). Otto Bock disclaims any liability related from medical decisions made based on this article summary.