Reference

Engel K, Brüggemann G-P, Heinrich K, Potthast W, Liebau C.

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Do counteracting external frontal plane moments alter the intraarticular contact force distribution in the loaded human tibiofemoral joint?

Munich: Elsevier 2015, The Knee 22: 68–72

Products

Genu Arthro

Major Findings

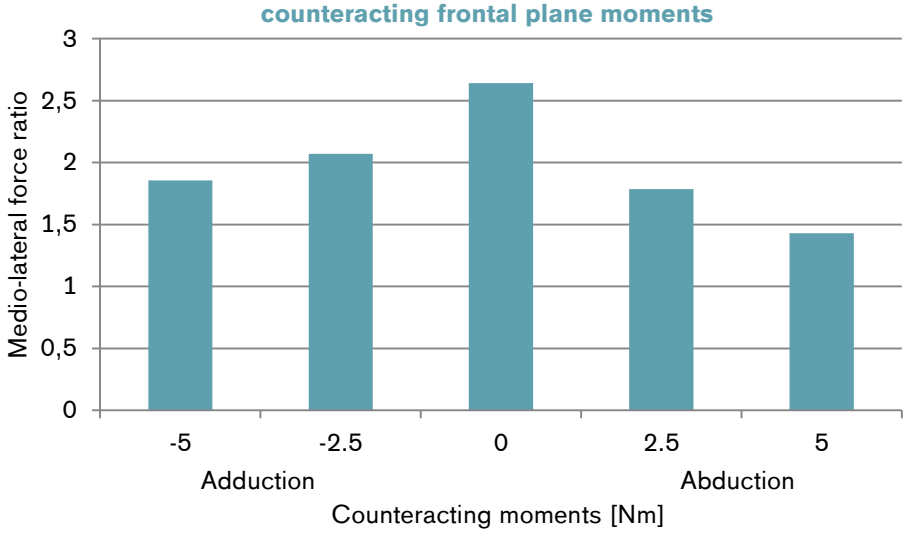
With Genu Arthro:

→ A higher knee flexion, leads to an increase of the medial compartment loading (varus and valgus alignment)

→ Counteracting abduction moments have a higher positive influence on the force in the medial knee joint compartment than adduction moments for the lateral compartment.

→ The same level of counteracting moment in valgus alignment results in a much higher shift of the COP than in varus alignment.

Average of medio-lateral force ratio in dependence of the counteracting frontal plane moments



The applied counteracting abduction moments led to higher redistributions than the applied adduction moments.

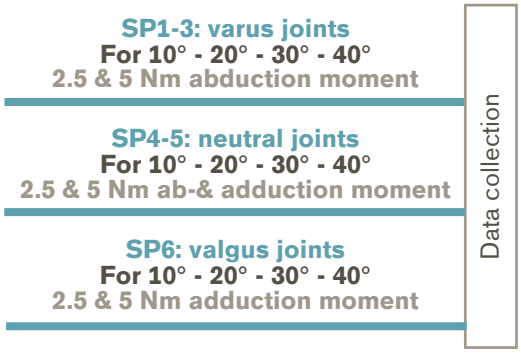
Population

Ex vivo: 6 cadaver legs (4 female, 2 male) (59-101 yrs)

SP1-3: varus joint
SP4-5: neutral
SP6: valgus joint

Study Design

Interventional, comparative:



One cylinder on top of the simulator was used for the up and down movements of the sliding bar. The steel cylinder with the femur was attached to a ball joint fixed to this sliding bar. A predefined range of motion from 10° to 40° flexion of the knee joint was measured on the lateral side of the legs using a goniometer. A reference trial without any applied frontal plane moments was captured of all joints. With Genu Arthro counteracting abduction moments of 2.5 and 5 Nm were applied to the varus joints, adduction moments to the valgus joint, respectively. The neutral aligned joints were tested under all conditions. Each condition was repeated five times. The negative sign indicates applied abduction moments.

Results

Functions and Activities						Participation
Biomechanics – Static measures	**Biomechanics – Gait analysis**	**X-Ray**	**EMG**	**Functional tests**	**Clinical effects**	**Satisfaction**

Category	Outcomes	Results for Genu Arthro	Sig.*
Biomechanics – Static measures	Knee flexion angle	increasing knee flexion angles, the forces in the medial compartment increase, even for the knee joint aligned in varus	n.a.
		Medio-lateral force ratio (>1→med. knee joint comp.)	

Flexion	*SP1*	*SP2*	*SP3*	*SP4*	*SP5*	*SP6*
10°	1.8	5.1	1.5	0.8	1.3	0.2
20°	2.1	5.4	1.7	1.8	1.5	0.3
30°	2.8	5.9	2.2	2.7	2.2	0.5
40°	3.2	6.3	2.5	3.9	3.0	0.6

		The joints aligned in varus (SP1–3) and neutral (SP4-5) show higher loading in the medial compartment, whereas more load is transferred through the lateral compartment in the knee joint aligned in valgus (SP6).	
	Medio-lateral force-ratio	The applied counteracting abduction moments lead to higher redistributions than the applied adduction moments.	n.a.
	Shift of the COP (centre of pressure)	The largest COP shift effect of 4.3 mm to the medial side is found in the joint in valgus alignment when a 5 Nm adduction moment is applied. By comparison, the highest COP shift for the lateral side is 1.8 mm.	n.a.

* no difference (0), positive trend (+), negative trend (–), significant (++/––), not applicable (n.a.)

Author's Conclusion

"The current study demonstrated that direct intraarticular measurements could be used to study the relationship between knee joint compartment loading and mechanically induced external moments. The presented findings have clinical relevance and offer novel insights to guide development and optimization of mechanical aids for the treatment of the osteoarthritic knees. Future of load redistributing knee orthotics should consider adaptive approaches to apply frontal plane moments dependent on the movement phase since the intraarticular load is related to the knee joint flexion angle." (Engel et al. 2015)