Reference

Paul Schwanitz von Keitz[1], Dana Kleimeier[2], Christoph Fabian Lutter[3], Mirko Rehberg[4], Wolfram Mittelmeier[3], Richard Kasch[3], Katrin Osmanski-Zenk[3], Susanne Föhlich[3]

The effect of the design of the orthosis on the axial load transmission of two flexion abduction orthoses used in treating congenital hip dysplasia

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Products

Tübinger Splint

Major Findings

With Tübinger Splint compared to hip flexion abduction orthosis ("Hüft-Beuge-Spreizorthese nach Mittelmeier Graf"):

→ Tübinger splint produced higher axial forces (mean = 15.1 N) compared to the hip flexion abduction orthosis (mean = 4.09 N).

- The higher axial forces observed in the Tübinger splint mean that more mechanical load is applied to the infant's body and the hip joint. However, this does not necessarily lead to a better development of the joint.

→ Movement phases increased axial forces in both orthoses.

→ The design of the orthosis significantly influences axial load transmission to the infant's body

- Significant correlation between body weight and axial force was found for the Tübinger splint for the following parameters:
  - Maximum (p=0.015) & mean (p=0.037) of all sensor measurements
  - Maximum of sensor measurements while resting (p=0.017) & while moving (p=0.047)
  - Standard deviation while resting (p=0.022)
- This indicates that heavier infants develop a higher axial load in the Tübinger splint compared to lighter infants, whether they are moving or resting.

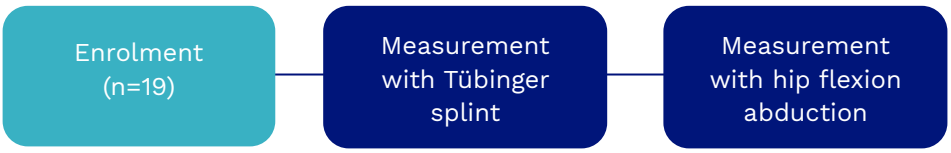
Population

Subjects:	19 children, (10 female, 9 male)
Clinical condition:	No indication of skeletal malformations with Type 1 hip joints on both sides according to Graf*
Mean age:	2.63 days (range: 1-day to 7-days-old)
Mean weight:	3495g (range 2800g – 4300g)

*Graf classification: an ultrasound-based system to assess developmental dysplasia of the hip (DDH), Type I being a normal, healthy hip

Study Design

Prospective comparative within-subject:



After an adjustment phase, measurement began with three sensors which were integrated into the orthosis used, for defined period of two minutes. Measurements are highlighted according to calm and active phases (leg kicking/stretching). Phases were subsequently calculated mathematically from the force vectors.

Results

Functions and Activities						Participation	Environment
Biomechanics – Static Measurement	**Biomechanics – Gait analysis**	**X-Rays**	**EMG**	**Functional tests**	**Clinical effects**	**Satisfaction**	**Health Economics**

Category	Outcomes	Results for Tübinger splint vs. hip flexion abduction orthosis	Sig.[a]
(Biomechanics – Static Measurement) Sensor Measurements	Mean axial force [N]	Higher mean axial load with the Tübinger splint (15.1 N ± 2.46 N) than with the hip flexion abduction orthosis (4.09 N ± 0.65 N). Axial forces increased for: - Infant movement: by factor 2.23 for Tübinger splint and 2.63 for hip flexion abduction orthosis. - Body weight: cumulative increasing ratio between acting force & body weight.	n.a.
Correlation between length and force parameters	No significant correlation parameters between length and any force parameter were found for both orthoses.		0
Correlation between weight and force parameters	Significant correlation between body weight and axial force was found for the Tübinger splint, not for the hip flexion abduction orthosis. Correlation coefficient values for the Tübinger splint:		++

	Correlation* (weight/power)	
Max. of all sensor measurements	0.55	++
Mean of all sensor measurements	0.48	++
Max. of all sensor measurements while resting	0.54	++
Standard deviation while resting	0.52	++
Max. of measurements while moving	0.46	++

Category	Outcomes	Results for Tübinger splint vs. hip flexion abduction orthosis	Sig.[a]

[a] no difference (0), positive trend (+), negative trend (–), significant (++/––), not applicable (n.a.)
*Correlation coefficients were interpreted according to conventional thresholds proposed by Cohen (1988) (small: r = 0.1–0.3, moderate: r = 0.3–0.5, large: r ≥ 0.5)

Author's Conclusion

"This study proves that the orthotic design has an influence on the infant's axial load. Moreover, a higher body weight is also accompanied by a higher average degree of axial forces. Irrespective of this statistical finding, it must be emphasized that in the long-term, both examined orthoses haven proven themselves in the treatment of DDH." (von Keitz et al., 2022)

Author's Affiliation

[1] Rehafachzentrum Bad Füssing, Orthopädische Klinik, Waldstraße 12, 94072, Bad Füssing, Germany

[2] Institut für Bioinformatik, Universitätsmedizin Greifswald, Germany

[3] Orthopädische Klinik und Poliklinik, Universitätsmedizin Rostock, Germany

[4] Universität zu Köln, Medizinische Fakultät und Uniklinik Köln, Klinik und Poliklinik für Kinder und Jugendmedizin, Köln, Germany