

Tübingen Hip Flexion Splint



Quality for life

Clinical Study Summaries

This document summarizes clinical studies conducted with the Tübingen Hip Flexion Splint. The included studies were identified by a literature search made on PubMed and within the journals Orthopädie-Technik, Medizinisch Orthopädische Technik, Neurologie & Rehabilitation and Journal of Pediatric Orthopaedics.

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1 Overview table

The summaries are organized in three levels depending on the detail of information. The overview table (Level 1) lists all the relevant publications dealing with a particular product (topic) as well as researched categories (e.g. gait analysis, clinical effects, satisfaction, etc). By clicking on underlined categories, a summary of all the literature dealing with that category will open (Level 2).

For those interested to learn more about individual studies, a summary of the study can be obtained by clicking on the relevant reference (Level 3).

Reference		Category						
		Functions and Activities						Participation
Author	Year	Biomechanics – Static measures	Biomechanics – Gait analysis	X-Ray	EMG	Functional tests	<u>Clinical effects</u>	Satisfaction
<u>Pavone</u>	2015						x	
<u>Atalar</u>	2014						x	
<u>Seidl</u>	2012						x	
Total number: 3		0	0	0	0	0	3	0

2 Summaries of categories

On the following pages you find summaries of categories researched in several studies (e.g. gait analysis, clinical effects, satisfaction, etc.). At the end of each summary you will find a list of reference studies contributing to the content of the particular summary.

Clinical effects

Major Findings

With Tübingen hip flexion splint:

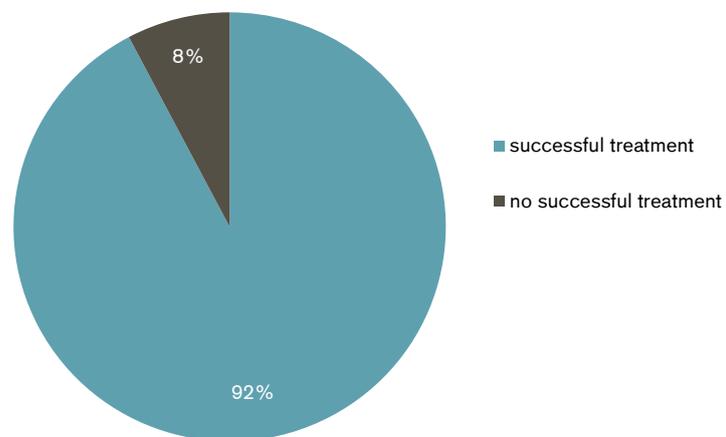
→ **92% to 98% of hips were successfully treated**

hip type 1 according to Graf (Atalar et al. 2014; Pavone et al. 2015; Seidl et al. 2012)

no acetabular dysplasia (Atalar et al. 2014)

→ **Complications due to treatment were only reported in 0.55% of the treated hips** (Pavone et al. 2015)

Amount of successful treatment of hip dysplasia with the Tübingen hip flexion splint (total number of treated hips: 544)



Clinical Relevance

“Developmental dysplasia of the hip (DDH) includes a series of anomalous conditions where hip joint dislocation, instability, or malalignment is present (Pavone et al. 2015).” Making reference to Ziegler et al. (2008) the incidence of DDH in Central Europe is between 2% and 4% with a luxation rate ranging from 0.5% to 1%. DDH is mainly diagnosed by ultrasonography (Pavone et al. 2015). The classification system of Graf (2007) allows the classification of hip types according to the severity of DDH.

The Tübingen hip flexion splint, described by Bernau (1990), aims at achieving and maintaining reduction of the hip by providing abduction and flexion. An advantage of the Tübingen hip flexion splint is that the child is able to move the knee and ankle joints while the splint is applied. Important factors influencing treatment success are early diagnosis and early treatment (Atalar et al. 2014).

Summary

Three studies evaluated the effectiveness of the Tübingen hip flexion splint:

92.28-98% of the observed hips were successfully treated with the Tübingen hip flexion splint (Atalar et al. 2014, Pavone et al. 2015, Seidl et al. 2012).

Complications (in form of avascular necrosis) due to treatment were only observed in 0.55% of hips (Pavone et al. 2015).

References of summarized studies

Atalar, H., Gunay, C., & Komurcu, M. (2014). Functional treatment of developmental hip dysplasia with the Tübingen hip flexion splint. *Hip International*, 24 (3): 295-301.

Pavone, V., Testa, G., Riccioli, M., Evola, F. R., Avondo, S., & Sessa, G. (2015). Treatment of Developmental Dysplasia of Hip With Tubingen Hip Flexion Splint. *Journal of Pediatric Orthopaedics*, 35: 485-489.

Seidl, T., Lohmaier, J., Hölker, T., Funk, J., Placzek, R., & Trouillier, H. H. (2012). Die Tübinger Hüftbeugeschiene als Repositionsorthese?. *Der Orthopäde*, 41 (3): 195-199.

Other References

Bernau, A. (1990). The Tübingen hip flexion splint in the treatment of hip dysplasia. *Zeitschrift für Orthopädie und Unfallchirurgie*, 128 (4): 432-435.

Graf, R. (2007). The use of ultrasonography in developmental dysplasia of the hip. *Acta Orthopaedica et Traumatologica Turcica*, 41 (S1): 6-13.

Ziegler, J., Thielemann, F., Mayer-Athenstaedt, C., & Günther, K.-P. (2008). Natürlicher Verlauf von Hüftreifeungsstörungen und Hüftdysplasie. Eine Metaanalyse publizierter Literatur. *Der Orthopäde*, 37: 515-524.

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3 Summaries of individual studies

On the following pages you find summaries of studies that researched Tübingen Hip Flexion Splint. You find detailed information about the study design, methods applied, results and major findings of the study. At the end of each summary you also can read the original study authors' conclusions.

Reference

Pavone, V., Testa, G., Riccioli, M., Evola, F. R., Avondo, S., & Sessa, G.

Department of Orthopedics, Azienda Ospedaliero-Universitaria Policlinico Vittorio Emanuele, Catania, Italy.

Treatment of Developmental Dysplasia of Hip with Tübingen Hip Flexion Splint

Journal of Pediatric Orthopaedics 2015, 35: 485-489.

Products

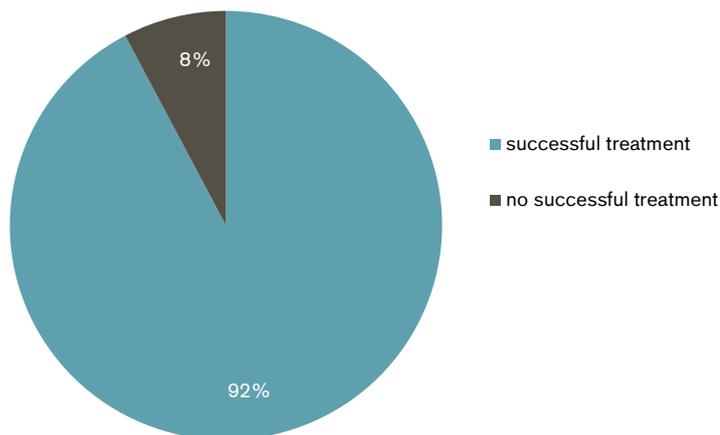
Tübingen Hip Flexion Splint

Major Findings

With Tübingen hip flexion splint:

- **92% of the treated dysplastic, unstable or dislocated hips were successfully converted into type 1 hips with an α -angle of $>64^\circ$ in the splint**
- **In 0.55% of hips complications were reported**
- **No statistic significant relationship between duration of therapy and time when treatment was started if treatment was started early within the first week of life**

Amount of successful treatment of hip dysplasia with the Tübingen hip flexion splint



Population

Subjects:	351 children with 544 hips requiring treatment 248 female, 103 male
Inclusion criteria:	hip dysplasia
Hip dysplasia:	158 unilateral, 193 bilateral Type (according to Graf): IIb (355), IIc-IId (127), III (51), IV (11)

Study Design

Retrospective study:



After fitting with the Tübingen hip flexion splint hip maturity was evaluated every 3 to 4 weeks until hip maturity was reached. Afterwards the weaning period started with in which the harness was only dressed for night time (14 hours a day) for a period of 4 to 10 weeks. Yearly follow-up evaluations were performed until skeletal maturity.

Results

Functions and Activities						Participation
Biomechanics – Static measures	Biomechanics – Gait analysis	X-Ray	EMG	Functional tests	Clinical effects	Satisfaction
Category	Outcomes	Results for Tübingen hip flexion splint				Sig.*
Clinical effects	Classification of Graf	92.28% of the treated dysplastic, unstable or dislocated hips were successfully treated				n.a.
		0.55% of hips showed avascular necrosis				n.a.
		In 1.65% of hips reduction under general anesthesia was necessary, followed by cast for 6 weeks				n.a.
	Severin classification	Hips of patients aged over 6 years and with hip type of IIc-IId, III or IV were evaluated				n.a.
		92.4% of hips showed good outcome (type I or II)				
		7.6% of hips showed poor outcome (type III or IV)				n.a.
	Mean age at start of treatment	39 days				n.a.
		No statistically significant relationship between duration of therapy and time when treatment was started (if treatment was started early within the first week of life)				0
	Mean duration of treatment	3.8 months				n.a.
	Mean follow up	6.4 years				n.a.

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

Author's Conclusion

“In conclusion, Tübingen harness, derived from Pavlik harness, has undergone a positive development and improvement and represents the treatment of choice in the DDH. This brace has shown a high success rate with a reduction in the incidence of short-term complications and developmental disorders of hip joint. Important factors are represented by an early age of beginning of the treatment, by its duration and by close ultrasonographic monitoring to evaluate the evolution of the condition and the possible occurrence of complications. Surgical treatment remains the last choice for patients in whom conservative treatment has failed.” (Pavone et al. 2015)

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Reference

Atalar, H., Gunay, C., & Komurcu, M.

Department of Orthopaedic Surgery and Traumatology, Gazi University School of Medicine, Ankara, Turkey.

Functional treatment of developmental hip dysplasia with the Tübingen hip flexion splint

Hip International 2014, 24 (3): 295-301.

DOI: 10.5301/hipint.5000128.

Products

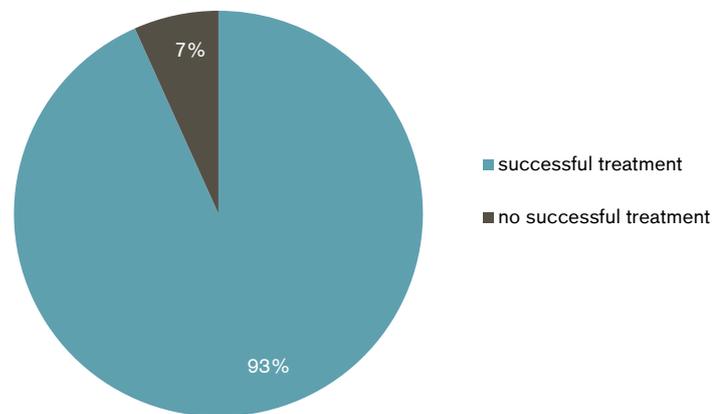
Tübingen Hip Flexion Splint

Major Findings

With Tübingen hip flexion splint:

→ **93% of the examined hips were successfully treated**
(Graf type 1 and no acetabular dysplasia)

Amount of successful treatment of hip dysplasia with the Tübingen hip flexion splint



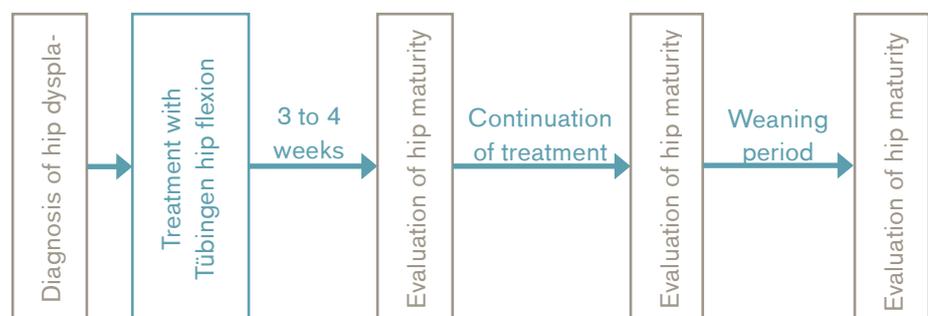
Population

Subjects: 49 children with 60 hips requiring treatment
45 female, 4 male

Inclusion criteria: diagnosis of hip dysplasia

Study Design

Retrospective study:



Hip maturity was assessed after 3 to 4 weeks of wearing the orthosis. If an improvement in hip maturity was observed treatment was continued with regular follow-ups. After acetabular maturation the weaning period was started where the splint was removed for a specific (growing) period of time per day.

Results

Functions and Activities						Participation
Biomechanics – Static measures	Biomechanics – Gait analysis	X-Ray	EMG	Functional tests	Clinical effects	Satisfaction
Category	Outcomes	Results for Tübingen hip flexion splint				Sig.*
Clinical effects	Classification of Graf	93.3% of hips were successfully treated				n.a.
		6.7% of hips could not be treated successfully				n.a.
		Successfully treated hips did not differ from unsuccessfully treated hips with respect to initial hip stability findings (stable vs. others), Graf type (type 2b vs. others) or number of hips involved (bilateral vs. unilateral)				0
	Median age at start of therapy	18 weeks				n.a.
		Successfully treated hips did not differ from unsuccessfully treated hips with respect to age at start of treatment				0
	Median duration of treatment (without weaning period)	8 weeks				n.a.
	Median duration of weaning period	8 weeks				n.a.
	Median total treatment time	17 weeks				n.a.
Median duration of follow up	13.5 months				n.a.	
	No avascular necrosis, femoral nerve dysfunction or skin lesions related to the splint were observed				n.a.	

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

Author's Conclusion

“The Tübingen splint provides abduction, but due to its different design it offers the advantages of preventing hip adduction and leaving the knee and ankle joints free. Our findings suggest that in infants with DDH, the Tübingen hip flexion splint is an effective form of treatment.” (Atalar et al. 2014)

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Reference

Seidl, T., Lohmaier, J., Hölker, T., Funk, J., Placzek, R., & Trouillier, H. H.

Centrum für Muskuloskeletale Chirurgie, Sektion Kinder- und Neuroorthopädie, Charité-Universitätsmedizin Berlin, Campus Virchow-Klinikum, Berlin, Germany.

Reduction of unstable and dislocated hips applying the Tübingen hip flexion splint

Die Tübinger Hüftbeugeschiene als Repositions-orthese?

Der Orthopäde 2012; 41: 195-199.

Products**Tübingen Hip Flexion Splint**

Major Findings

With Tübingen hip flexion splint:

→ **98% of hips were successfully treated (successfully converted into type I hips with an α -angle of more than 64° in the splint)**

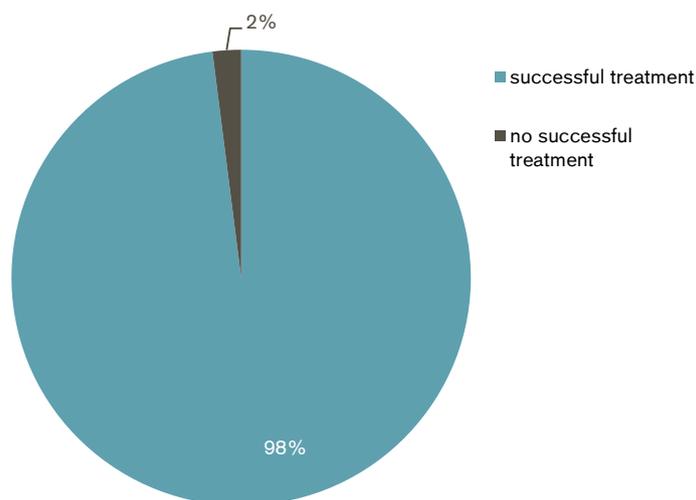
Mean time for achieving an α -angle $\geq 64^\circ$: 51.6 ± 18.9 days

→ **2% of hips (type IV hip) could not be reduced**

→ **No significant relationship between duration of therapy and time when treatment was started if start of treatment was within the first week of life**

→ **No correlation between duration of therapy and initial hip type**

Amount of successful treatment of hip dysplasia with the Tübingen hip flexion splint



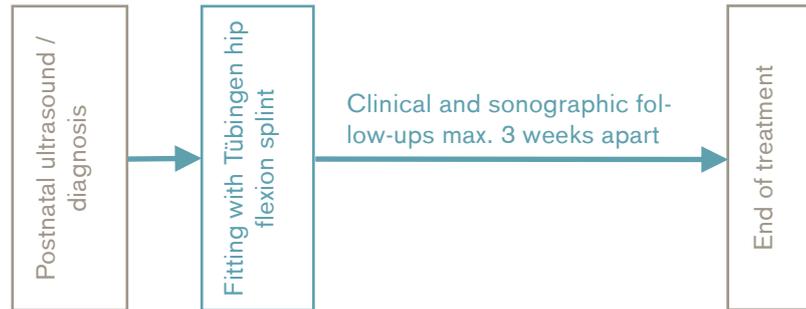
Population

Subjects: 42 newborns with 50 hips requiring treatment
35 female, 7 male

Hip dysplasia: 34 unilateral, 8 bilateral
Type (according to Graf):
IIc unstable (6), D (33), IIIa (10), IV (1)

Study Design

Prospective cohort study:



Results

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

Category	Outcomes	Results for Tübingen hip flexion splint		Sig.*
Clinical effects	Classification of Graf	98% of unstable or decentered hips were successfully treated		n.a.
		2% of hips (type IV) could not be treated successfully		n.a.
	Mean age at beginning of therapy	3.5 days		n.a.
	Duration of therapy	Mean	51.6 ± 18.9 days	n.a.
		<i>Beginning of therapy</i>	<i>Duration</i>	0
		day 1 – 4	49.8 ± 18.6 days	
		day 5 – 8	59.7 ± 19.5 days	
	<i>Type of hip dysplasia</i>	<i>Duration</i>		0
		IIc unstable	54.0 ± 17.0 days	
		D	50.9 ± 18.9 days	
		III	52.6 ± 21.9 days	

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

Author's Conclusion

“When recognized within the first week of life dysplastic unstable hips (type IIc unstable according to the classification of Graf) and dislocated hips with a cranially dislocated cartilage roof (types D and III according to the classification of Graf) can be successfully treated with the Tübingen hip flexion splint provided that the parents show good compliance concerning the treatment regimen.” (Seidl et al. 2012)

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