Reference

Prema Ananda Dewa Gde[1]; Deyana Novita Siahaan[1]; Luky Tandio[2]; Ronald Vinantius Munthe[1,3]

The efficacy of Tübingen splint in developmental dysplasia of the hip in children under 6 months: A systematic review and meta-analysis

Medicine (Baltimore) 104(32): e43753, August 2025.
DOI: 10.1097/MD.0000000000043753. Open Access.

Products

Tübingen hip flexion splint

Major Findings

With Tübingen hip flexion splint:

→ High overall success rate

- Patients treated with a Tübingen splint showed an overall success rate of 86% ($p < 0.01$).

→ Success differs according to Graf classification

- Especially for immature or mildly dysplastic, cantered hips (Graf II) and decentred hips (Graf III) success rate is high, 97% for hips classified as Graf II ($p < 0.01$) and 94% for hips classified as Graf III ($p = 0.41$).
- For dislocated hips which are classified as Graf IV the success rate is significantly lower with 48% ($p < 0.01$).

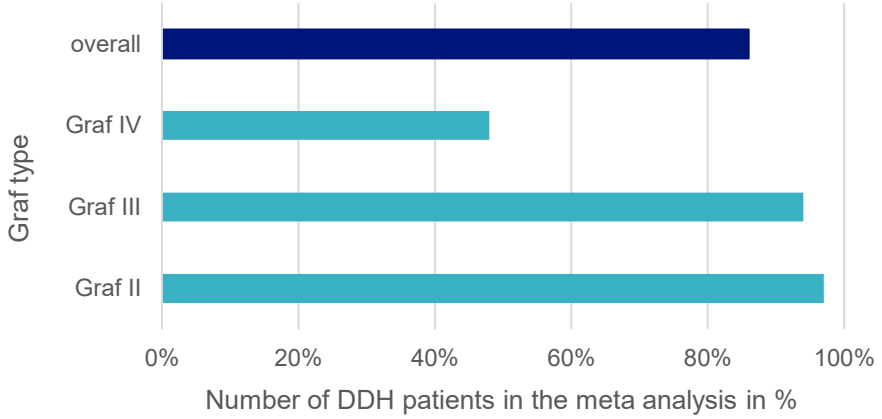


Figure 1: Success rate of DDH treatment with Tübingen splint according to Graf classification

→ Low complication rate

- The overall complication rate across the meta-analysis was at 2% ($p < 0.01$).
- The rate of avascular necrosis (AVN) was 1% ($p = 0.47$)
- The incidence of residual acetabular dysplasia (RAD) was 6% ($p = 0.69$)
- The risk of femoral nerve palsy is extremely rare with only 1 reported case.

→ Advantages over traditional methods

- The Tübingen hip flexion splint maintains optimal hip position (90°–110° flexion, 40°–45° abduction) and has shown higher effectiveness than the Pavlik Harness (PH), another soft splint, by reliably sustaining flexion and limiting adduction.
- It reduces risk of hyperabduction, thereby lowering the risk of avascular necrosis (AVN) compared to the PH.
- It is easier to handle and more hygienic, as it can be temporarily removed.

Population

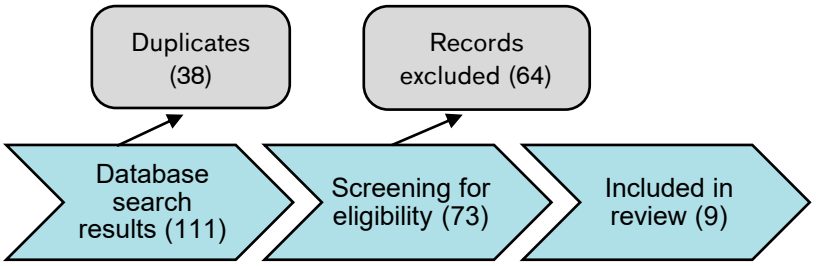
Subjects:	1063 children (864 female, 199 male), (affected hip joints: 1456)
Clinical conditions:	Confirmed diagnosis of developmental dysplasia of the hip (DDH) with Graf classification (IIa, IIb, IIc, IId, III, and IV)*
Mean age:	Under 6 months at the beginning of treatment
Individual study designs:	7 retrospective studies (n=678), 2 prospective studies (n=385)

*Graf classification: an ultrasound-based system to assess developmental dysplasia of the hip (DDH)

Typ I	Type IIa	Type IIb	Type IIc	Type IId	Type III	Type IV
normal	immature	dysplastic	critical dysplastic	decentered	subluxated	fully dislocated

Study Design

Systematic literature review and meta-analysis:



A systematic review was conducted following the PRISMA guidelines. The literature search was performed in the databases Scopus, Embase, PubMed, Cochrane, and Google Scholar without restrictions on publication year, but limited to English-language articles. Boolean operators were applied, and the search terms included 'Tübingen splint AND infant AND DDH'. Two authors independently assessed the quality of the full-text articles using the Newcastle-Ottawa Scale to evaluate the quality of observational studies.

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 Tübingen splint	Sig.[a]
Clinical Effects	Success rate	Overall success rate across the meta-analysis: 86%	++
		Graf II (stable hips): 93% success Graf III & IV (unstable hips): 40% success	Zhou
		Comparison to Pavlik Harness (PH): superior results with Tübingen splint for Graf II–III	Nairm, Lyu

Category	Outcomes	Results for Tübingen splint	Sig.[a]
	Long term	12-year follow-up (after successful treating initially unstable hips): • normal findings increased from 52.8% → 81.1% • severe dysplasia decreased from 8.3% → 0%.	Kubo
	Complications	Overall complication rate across the meta-analysis: 2%	++
		Breakdown of complications: AVN was observed in 10 patients (34.5%), RAD in 18 patients (62%), and transient femoral nerve palsy occurred in 1 patient (3.5%)	Nair, Lyu
		Tübingen splint provides more stable flexion and limited adduction which reduces the risk of AVN.	Murnaghan
		Femoral nerve palsy is more common in patients treated with the PH	Ghanem
		Atalar et al. reported no complications in their series, including no cases of AVN, femoral nerve dysfunction, or skin lesions, even though it included children who had failed previous treatment methods.	Atalar
Satisfaction	Handling	Tübingen splint surpasses others in comfort and ease of handling.	Chaibi, Kubo
	Hygiene	The removable design allows brief breaks for hygiene (e.g., bathing, diaper changes), helping prevent skin irritation or infection.	Seidl

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

Author's Conclusion

"The Tübingen splint demonstrated significant success and minimal complication rates in the treatment of DDH. Notably, it can be effectively used to treat unstable hips with promising outcomes for Graf type II and III DDH. However, regular adjustment and careful monitoring are essential for effective correction and patient safety. The long-term success of managing DDH in clinical practice depends on a personalized approach for each child's specific needs." (Dewa Gde et al., 2025)

Author's Affiliation

[1]Faculty of Medicine, Christian University of Indonesia, Christian University of Indonesia Hospital, Jakarta, Indonesia

[2]Department of Orthopedic and Traumatology, Dr. R. Soedjono Selong Hospital, Lombok, Indonesia

[3]Department of Orthopedic Surgery, Christian University of Indonesia Hospital, Jakarta, Indonesia

Author's References

Lyu X, Chen T, Yang Z, et al. Tübingen hip flexion splint more successful than Pavlik harness for decentred hips after the age of three months. Bone Joint J. 2021;103-B:991–8.

Atalar H, Gunay C, Komurcu M. Functional treatment of developmental hip dysplasia with the Tübingen hip flexion splint. Hip Int. 2014;24:295–301.

Pavone V, Testa G, Riccioli M, Evola FR, Avondo S, Sessa G. Treatment of developmental dysplasia of hip with Tubingen hip flexion splint. J Pediatr Orthop. 2015;35:485–9.

Yegen M, Atalar H, Gunay C, Yavuz OY, Uras I, Kaptan AY. Reduction of the dislocated hips with the Tübingen hip flexion splint in infants. Int Orthop. 2019;43:2099–103.

Ran L, Chen H, Pan Y, Lin Q, Canavese F, Chen S. Comparison between the Pavlik harness and the Tübingen hip flexion splint for the early treatment of developmental dysplasia of the hip. J Pediatr Orthop B. 2020;29:424–30.

Zhou Y, Li R, Li C, et al. Tübingen hip flexion splints for developmental dysplasia of the hip in infants aged 0-6 months. BMC Pediatr. 2020;20:280.

Chaibi E, Saugy CA, Samara E, Zambelli PY, Merckaert SR. Comparison of treatment outcomes of stable and unstable developmental dysplasia of the hip with the Tübingen splint. Front Pediatr. 2022;10:976367.

Büyükceran I, Çınka H, Yurtbay A, et al. Treatment results of patients with developmental dysplasia of the hip, who were treated with tubingen hip flexion splint. J Exp Clin Med (Turkey). 2023;40:594–8.

Kubo H, Krauspe R, Pilge H, Westhoff B. Radiological long-term follow-up up to 12 years of initially ultrasound unstable hip types D, III and IV after treatment with the Tübingen splint worn as a plaster. Arch Orthop Trauma Surg. 2023;143:4871–8.