1 SpineAlign: Stabilization Device to Enhance Success Rates of Horizontal Lumbar Punctures in Pediatric Patients

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Need

- **Lumbar puncture (LP):** Needle insertion procedure to collect CSF in the intervertebral spinal area for meningitis diagnostic testing (**50% of neonates**)
- Failure rate is **40–50%** [1]
- Increase LP success for conclusive diagnosis and treatment

Existing Solution Limitations

- Smoltap stabilizes infants ≤ 2 months but is limited to a fixed vertical angle [2]
- Most physicians are trained in horizontal orientation

Objective

Stabilization device for horizontal LPs that:

✓ Is adjustable for infants from 0–6 months of age

✓ Provides an adequate amount of spinal curvature to increase intervertebral space while not obstructing airway

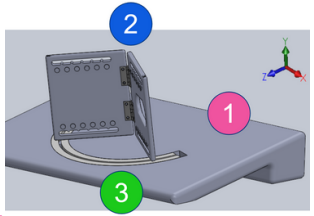
✓ Keeps the infant immobilized for the entire duration of the procedure (~30 mins)

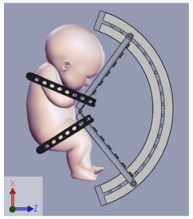
Design Inputs

Achieved Curvature	≤ 140° 
Strap Stability	10 N 
Airway Obstruction Prevention	Prevent Asphyxiation
Switch Orientations	 Left Right

Solution

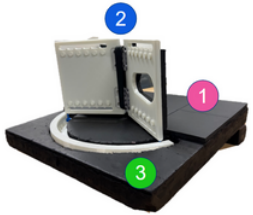
Design

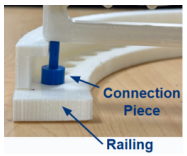


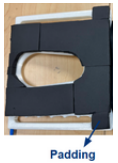


1. **Angled Base**
   - Elevate patient's back for increased comfortability during LP; padded with neoprene rubber
2. **Reversible Infant Support Piece – Upper and Lower**
   - Flex patient's spine from 0–140°
   - Immobilize infant for duration of LP with straps
   - Air hole to avoid asphyxiation; padded with neoprene rubber
3. **Railings**
   - Enables user to modify the device's angle and lock it there to maximize safety

Build

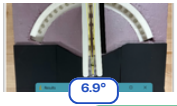


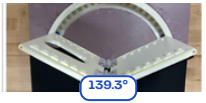




Verification Testing

Hinge Test (V1)
- Ensures device expands from 5° ± 5° to 140° ± 5°





Required Hinge Angle Range ✓

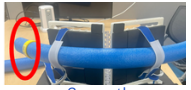
Stability Test (V2)
- Ensures device withstands 10N of intermittent force at varying angles for 30 min

Straps Secure ✓

Connection Pieces Secure X

Length Test (V3)
- Ensures device compatibility with the 5th to 95th percentile of infant heights up to 6 months

0-month 5th percentile → 6-month 95th percentile



0 – 6 M Length Compatability ✓

Conclusion & Future

Accomplishments
- Adjustment of lumbar angle from 0–140° compared to fixed angle of 140° in existing solution
- Extended patient population addressed (0–6 months)
- Horizontal patient positioning, more compatible with physician training

Future Revision
- Add locking mechanism to connection piece

Impact
- Improved horizontal LP success, reduced repeat procedures, and achieved conclusive diagnosis and treatment

DEMO VIDEO

Acknowledgements & References

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[1] Roehr, C. O., et al. (2023). Techniques to increase lumbar puncture success in newborn babies: the NeoCLEAR RCT. Health Technology Assessment

[2] SmolTap. "Infant Spinal Tap Solutions." Infant Spinal Tap | Smoltap, https://www.smoltap.com/