Belly Bundle Fetal Monitoring Assistant

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Abstract

The obstetric belly band, which holds the tocometer and ultrasound transducer in place, tends to bunch up during labor; this causes a great amount of discomfort to the expectant mother. In an effort to improve the existing belly band, we have designed a belly band to minimize both discomfort and cost while maximizing monitoring reliability. This design consists of a two-piece band with gathering on the sides, stiff elastic lining the back of the band, and a hook system. Future testing in hospitals will allow this product to be perfected and introduced to the competitive market.

Background

- 4 million babies are born in the United States a year[1]
- Electronic fetal monitoring is used during labor (from the time the expectant mother arrives at the hospital until she has given birth) to monitor the health of the fetus[2]
- An ultrasound transducer monitors fetal heart rate[3]
- A tocometer measures the frequency of uterine contractions[3]
- Belly bands or straps are used to hold these instruments in place[4]

Figure 1. Ultrasound and tocometer transducers.[5]

Figure 2. Current competition belly band and straps[4]

Mission

Our mission is to redesign an obstetric belly band so that it has more rigidity in the transverse direction and will not roll up during use. Current methods for securing the instruments are inefficient for nurses and uncomfortable for patients. The team's solution fits the needs of health care professionals using the device for monitoring purposes and ensures comfort for laboring women.

Acknowledgements

Lea Minton- Columbia University School of Nursing
Professor John Webster– BME Department
Professor Willis Tompkins– BME Department
Professor Kristyn Masters– BME Department
Professor John Puccinelli– BME Department
Dr. Lori Wendricks-House– St. Mary's Hospital
Taylor Heinselman- Textile Department
Kathy Frigge– Meriter Hospital
Karin Marshall– Abott Northwestern Hospital
Nora Webster– Frontier School of Midwifery
FetaBand, Inc

Final Design

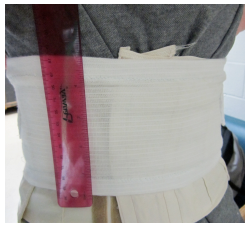


Figure 3. Stiff elastic, lining back of the band, minimizes rolling.

Figure 4. Final design: two-piece elastic cotton band attached with a gathered seam, elastic lining in back, and hooks to increase pressure.

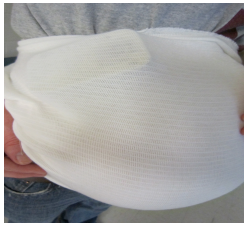


Figure 5. Fastened hook system increases pressure; improves monitoring device contact.

Item	Cost
Elastic cotton blend material	$2.00
Elastic strip	$1.59
Bra Back Extender (hooks)	$1.95

Table 1. Total cost of materials in single prototype: $5.54. Labor for fabrication not included. Material price is expected to decrease during mass-production.

Advantages
- Comfortable
- Reliable
- Universal
- Ease of Use

Specifications
- Secures monitoring devices
- Comfortable Fit
- 13 inch diameter
- 5 inches high in back
- 12 inches high in front
- Elastic Cotton Blend Fabric
- Contains no Latex
- Hooks for increasing pressure
- Costs $5.54

Testing

Belly Band	Prevents Rolling	Maximum Weight Supported	Comfort	Reliability	Tocometer Contact
Original Band	Bad	10 lb.	Uncomfortable, hot	Good	Good
Two-piece with gathering and elastic siding (mesh material)	Good	6 lb.	Comfortable	Poor	Poor
Two-piece with gathering and hook system (mesh material)	Poor	10 lb.	Comfortable	Poor	Good
Two-piece with gathering and elastic siding and hook system (belly band elastic)	Good	10 lb.	Comfortable	Good	Good

Table 2. Results of movement and weight tests on the four different bands.

Weight Tests- suspended 6lb and 10lb medicine ball for 1 minute to test the strength of stitching and fabric.

Movement Tests- Five minutes of continuous activity including:
- Sitting Up
- Rolling side to side
- Walking
- Sliding back and forth

Band	Length Before Activity	Length After Activity	Percent Compression
Original Band	14"	10"	28.6%
Two-piece band with no elastic	2.4"	2"	20%
Two-piece band with elastic	5"	4.75"	5.0%

Table 3. Fabric compression results of movement tests.

Results: Elastic lining in the back of the band prevents rolling, hooks increase pressure in the front of the band, and the mesh fabric is not durable enough to be used.

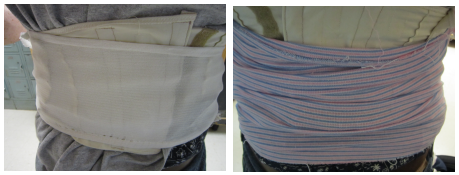
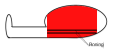


Figure 6. The band on the left displays minimized rolling (two-piece band with elastic), after movement tests. The band on the right displays maximum rolling (original belly band), after movement tests.

Alternatives

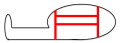
Structure:
- Uniform band with boning



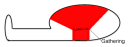
- Tapered band

- Formed hemisphere band

- Tracking system band



- Gathered band



Fastening Methods:
- Velcro
- Zipper
- Small Snaps
- Eye hooks
- None

Future Work

Obtain IRB
- Get a principle investigator
- Submit our design to the review board
- Keep review board up to date

Further Testing
- Once IRB is obtained, need to test on a laboring woman in a hospital setting
- Receive and correct any negative feedback

Produce Multiple Sizes
- Prototype is a smaller size to fit the simulated belly
- Need larger sizes to accommodate larger women

Streamline Production
- Need most efficient way to produce our design
- Obtain material directly to reduce costs
- Set up an automated system to manufacture the design

References

[1] "FASTSTATS - Births and Natality." 2011. Web. 24 Feb. 2011 <http://www.cdc.gov/nchs/fastats/births.htm>.
[2] Minton, Lea. Personal Interview. 20 Feb. 2011.
[3] Schifrin, B. S. 1990. *Excercises in Fetal Monitoring*. St. Louis: Mosby Year Book.
[4] "Fetal Monitoring Belts & Straps." *Advanced Medical Systems | Medical Products for Healthcare Facilities*. 2005. Web. 27 Feb. 2011. <http://www.ams-colorado.com/>.
[5] "Tocometers." 2011. Web. 8 Feb. 2011 <http://www.centrusmedical.com/tocos.html>.