Neo-Anal Sphincter Fabrication in the Rat

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Background: Cancers, diseases and accidents can lead to surgical removal of an individual's anal sphincter. Lack of a functioning anal sphincter can greatly decreases quality of life. Current medical options include medications and dietary changes, palliative care, such as diapers, pads, and anal plugs, and the use of devices such as the magnetic anal sphincter (MAS) and the Thiersh ring. Better solutions are needed. Our long term goal is validate methods for reconstructing a neoanal sphincter from autologous skeletal muscle. The purpose of my study is to determine the functioning characteristics of the latissimus dorsi muscle during steps of neoanal sphincter construction.

Method: In a rat model, the latissimus dorsi muscle is unilaterally elevated from its native position. The muscle is either replanted to the native position or rolled into a neosphincter. After time for recovery from surgery, the latissimus dorsi muscle and the neoanal sphincter are dissected free and evaluated for contractile pressure. At final evaluation, muscle tissues are harvested for histology.

Results: Latissimus dorsi muscles of the neoanal sphincter contracted with pressure similar to the native anal sphincter. The contractile force produced by the elevated and replanted latissimus dorsi muscle with a layer of biological scaffold was very similar to the elevated latissimus dorsi muscle without a biological scaffold.

Conclusion: Isolation of the latissimus dorsi muscle for reconstruction of neosphincters developed similar pressure as native anal sphincter muscles. Elevation of muscle for subsequent sphincter construction did not significantly compromise force capacity of the muscle.

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BACKGROUND

Cancers, diseases and accidents can lead to surgical removal of an individual's anal sphincter. Lack of a functioning anal sphincter can greatly decrease quality of life. Current medical options include medications and dietary changes, palliative care, such as diapers, pads, and anal plugs, and the use of devices such as the magnetic anal sphincter (MAS) and the Thiersh ring. Better solutions are needed. Our long term goal is validate methods for reconstructing a neoanal sphincter from autologous skeletal muscle. The purpose of our study is to determine the functioning characteristics of the latissimus dorsi muscle during steps of neoanal sphincter construction.

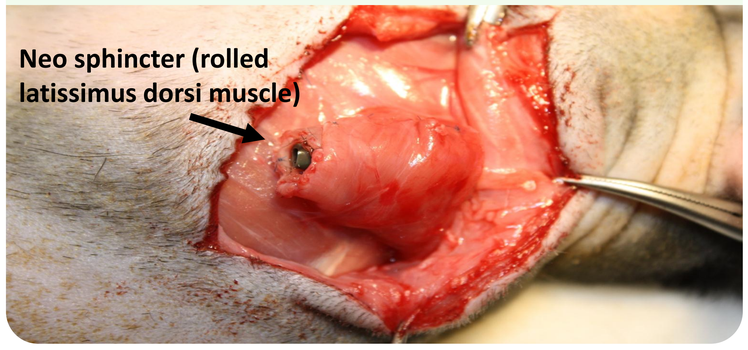

Figure 1. A rolled neo sphincter construct during surgery. The arrow indicates the lumen, with an obturator used during construction.

METHODS

In a rat model, the latissimus dorsi muscle is unilaterally elevated from its native position. The muscle is either replanted to the native position or rolled into a neo sphincter. After time for recovery from surgery, each latissimus dorsi muscle is again dissected free and contractile pressure and force are measured. Muscle tissues are harvested for histology.

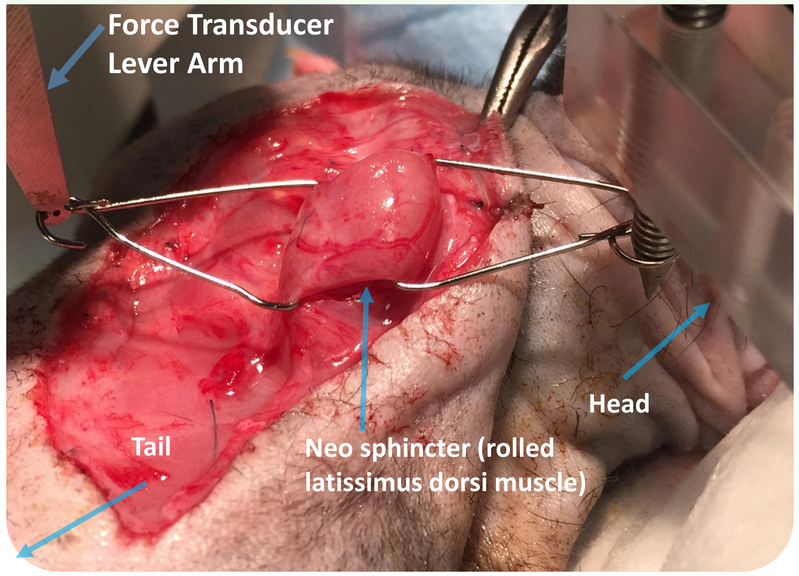

Figure 2. Neo sphincter positioned in equipment for force measurements 14 days after surgery.

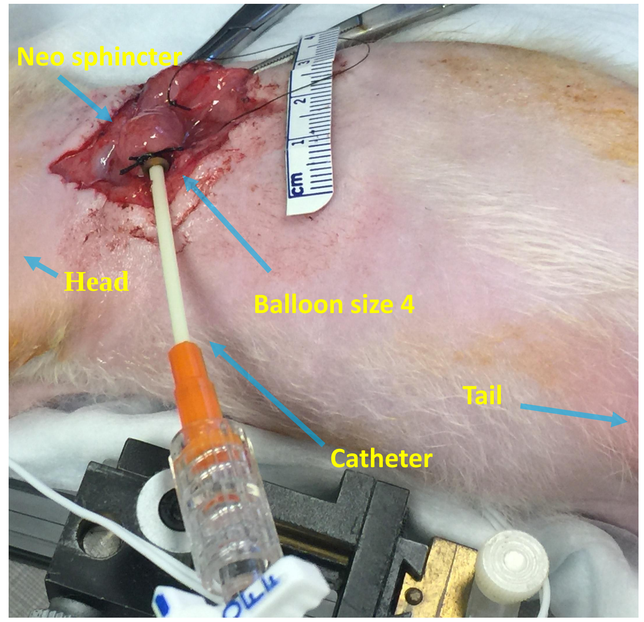

Figure 3. Measurement of pressure within the neoanal sphincter. A balloon attached to a catheter is inserted into the lumen of the neo sphincter. Mineral oil is injected into the balloon while pressure is acquired using a pressure transducer and oscilloscope.

CONCLUSION

Reconstructed neo-sphincters developed similar pressure as native anal sphincter muscles. Elevation of muscle for subsequent sphincter construction did not significantly compromise force capacity of the latissimus dorsi muscle. This model of neoanal sphincter construction is appropriate for future studies.

RESULTS

Table1. Summary data form neoanal sphincters evaluated 14 day after surgical construction using the latissimus dorsi muscle of the rat.

NeoSphincter		With Cells (n=9)	W/O Cells (n=6)
Non Stimulated	Peak Pressure (V)	3.09 (0.6)	3.16 (0.35)
Non Stimulated	Resting Pressure (V)	2.52 (0.56)	2.58 (0.48)
Stimulated	Peak Pressure (mV)	281 (236)	343 (309)
Stimulated	Peak Voltage needed for peak pressure(V)	7	7
Stimulated	Peak Frequency, median (Hz)	138	135

Values indicate mean (standard deviation).

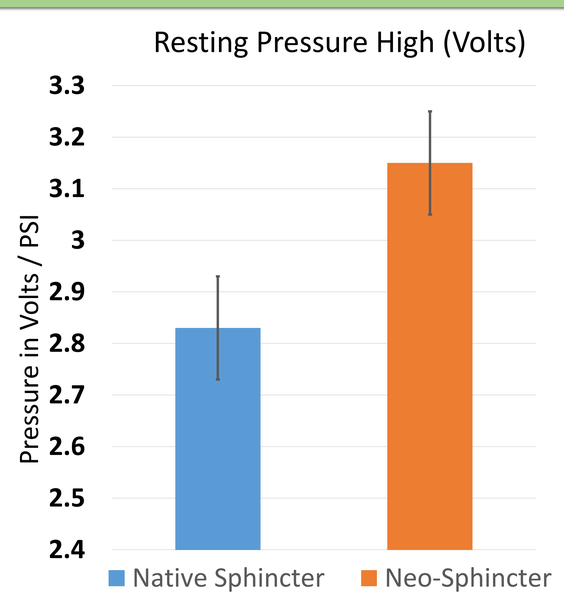

Figure 4. The data in the graph above shows the average resting pressure of the native anal sphincter of the rat in comparison to the neo sphincter that had been made.

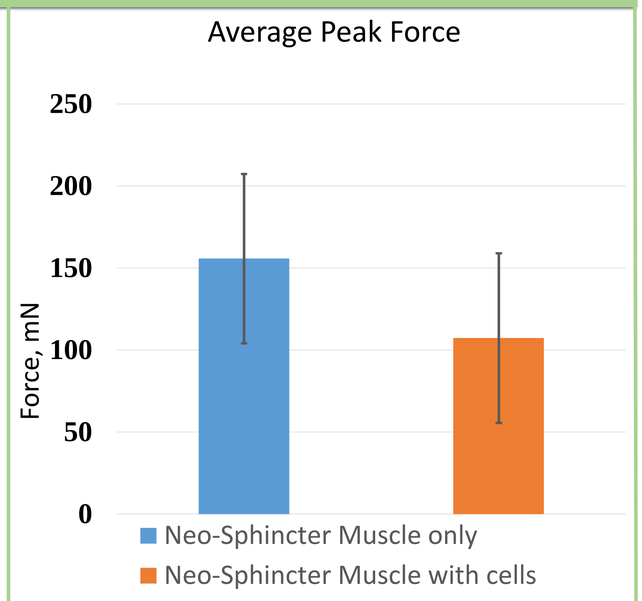

Figure 5. The data in the graph above shows the average peak forces for Neo-Sphincter muscle only compared to Neo-Sphincter muscle with cells.

ACKNOWLEDGEMENTS

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