# Feasibility Testing Report – Muscle Deflection Test

*Team: P15001: Active Ankle Foot Orthotic*
*Engineer: Tyler Leichtenberger – Mechanical Engineer*
*Engineer: Noah Schadt – Mechanical Engineer*

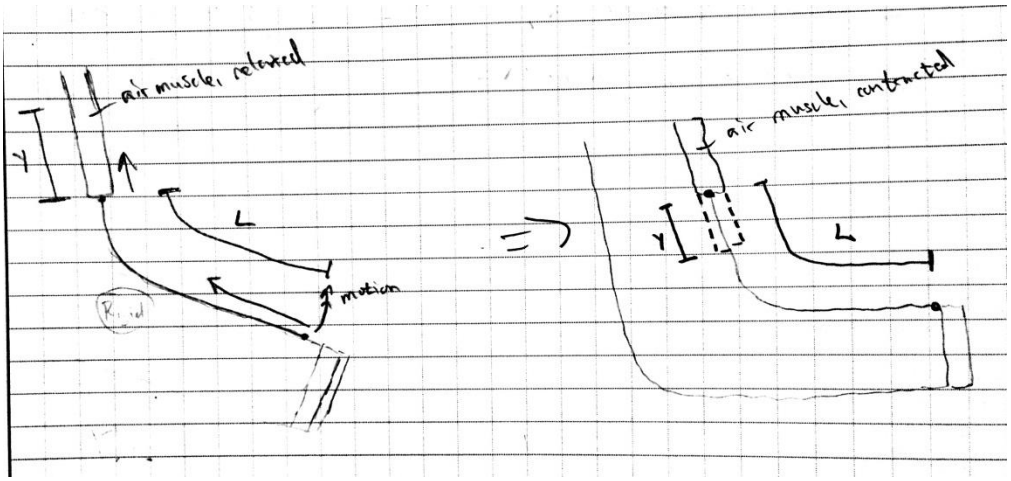
*Test Date: October 21, 2014*

## Related System: ABBBB- Raise Foot; ABBBC- Hold Foot

This test was done as a compliment to the test measuring how much force it would take to raise the foot to the desired position. This test helped determine how far the muscle must contract to raise the foot fully to the upright position during walking. This deflection, along with the force required, will help raise the foot to help the user have a natural gait cycle.

The key questions to be answered during this test were:

a. How far does the muscle need to contract to raise the foot?
b. Does the moment arm length have a significant effect on the length the muscle must contract
c. Is the deflection feasible for the air muscles that we are designing for the system?




## Testing Procedure

Materials needed:

- Tether (fishing line)
- 4 non-elastic straps
- Masking tape
- Ruler

1. 4 elastic straps will be used to simulate the function of the brace and tether, allowing the tether to run directly along the skin
    a. This is what will be done on our actual AFO, because it needs to be able to fit inside of the shoe

    b. Tether will somehow be attached to brace; these 4 straps helped simulate this
2. Fishing line tied to strap that will be wrapped around the base of the foot to simulate the location that the moment will be applied
    a. 2 locations tested: approximately 4 inches from the ankle, and approximately 5.5 inches from the ankle
3. Three additional straps attached to the lower leg- one higher up on the foot, one on the ankle, and one on the upper shin
4. Tether ran underneath the straps, along the skin, to simulate the function of the AFO
5. Small piece of masking tape wrapped around fishing line on the shin for a reference datum to determine how far the tether moves when the foot is raised
6. Tether tightened to be flush with the skin when the foot is dangling in the natural downward position
7. User moves foot to upward position
8. Tether tightened again to be flush with the skin
9. Distance masking tape datum has moved measured to determine the distance the muscle must contract, moving the foot to the upright position

*Figure (1): Foot in downward position*

*Figure (2): Foot raised in upward position*

## Results

| Deflection- 4 in Level Arm | |
|---|---|
| Distance Reference Mark Traveled | |
| | |
| Trial | Distance (in) |
| 1 | 1.00 |
| 2 | 1.00 |
| 3 | 1.00 |

| Deflection- 5.5 in Level Arm | |
|---|---|
| Distance Reference Mark Traveled | |
| | |
| Trial | Distance (in) |
| 1 | 1.00 |
| 2 | 1 1/8 |
| 3 | 1 1/8 |

## Conclusions

This test answered all our technical questions that we needed to ask:

1. The air muscle must contract 1 inch to raise the foot to the upright position
2. The level arm does not have a significant effect on the distance the muscle must contract
3. This deflection seems reasonable for our preliminary muscle design; however, this will be better answered going forward

## Next Steps

Going forward, this test is complete; the questions we asked were answered during our test. However, this test, paired with the force to raise the foot test, will feed into our Muscle Optimization Stage 2 test, which is our final muscle design for our AFO.