Testing Report – Extended Use Test Stage 1

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Related System: ABBBBB- Raise Foot

This test is an extension of the Lift_Foot_1 integrated test. The test is designed to subject the integrated mechanical components of the AFO to extended use testing to determine performance and reliability.

Testing Procedure

Supplies

1. Protractor
2. Packing tape
3. Video camera
4. Tracker software
5. AFO

Set-up

The test rig was set up according to Figure 1 with the protractor taped to the leg for tracker reference and the mechanically integrated AFO applied to the user's leg.

Figure 1: Test Set-up

Procedure

The procedure for stage one of the extended use test was simply to actuate the McKibben air muscle a total of **100** times and note lift measurements and changes over time if any.

Tracker software is available as a free download and was used to mine data from the video footage. Key points were selected on the rig, namely:

- Top of the protractor
- Bottom of the protractor
- Top of Muscle Base
- Heel
- Toe reference
- Leg reference

These points were tracked manually and visually frame by frame during a gait cycle.

Post Test

In addition to the extended use test an experimental post test was performed to mimic a worst case scenario. In the post test, the user stretched their toe downward as far as they could while the muscle

was flexed. Following this worst case situation, the basic foot lift test was performed again in order to quantify the impact that the worst case slippage had on AFO performance. Tracker was again used to mine data from the post test.

Results

The key resulting data from the extended use test consisted of primarily:

a) Length of protractor
b) Ankle angle (foot relative to the leg)
c) Muscle Base displacement

The results of the ankle angle from the first three flexes and flex 101 can be seen in Figure 2.

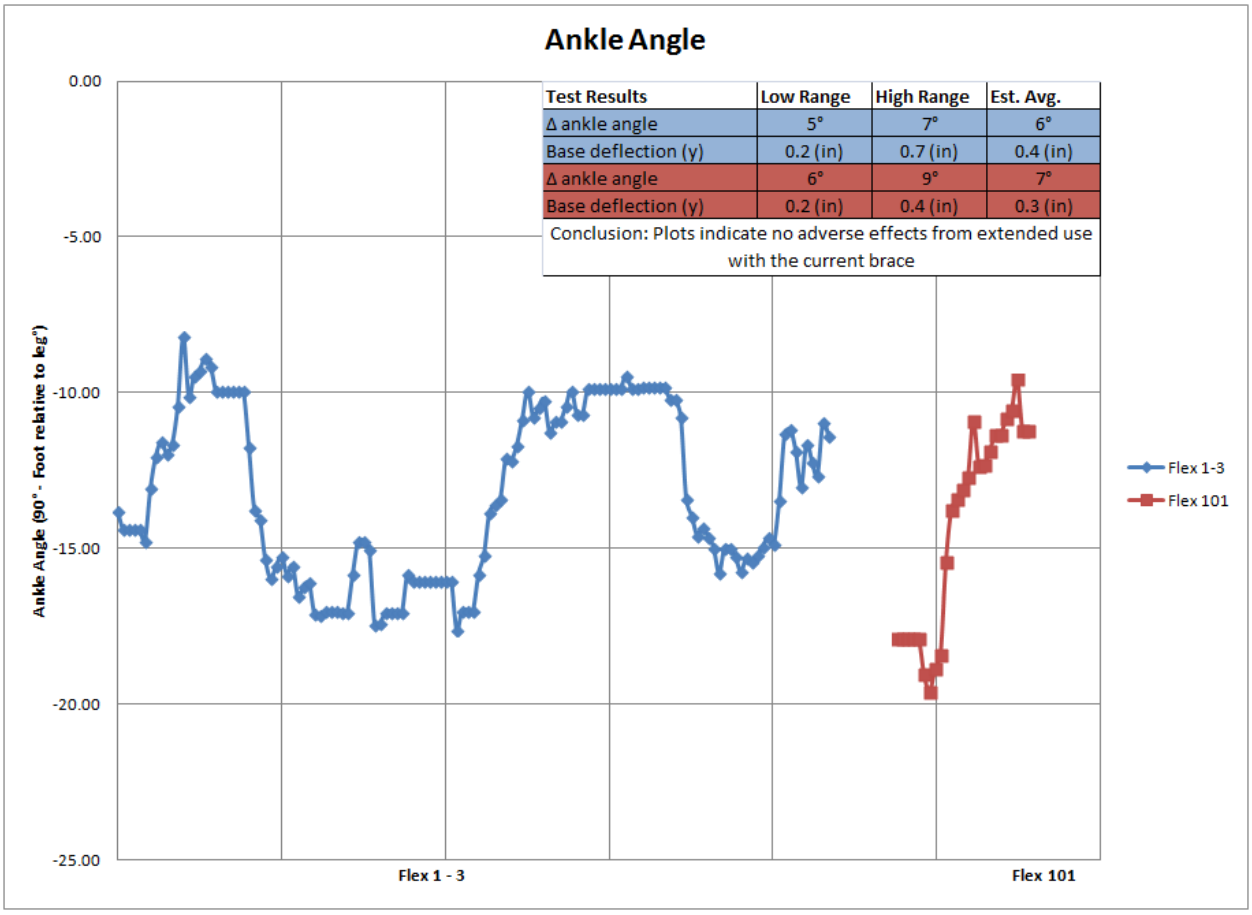

Figure 2: Ankle Angle

Similarly, the muscle base vertical displacement from flex 1-3 and 101 can be seen in Figure 3.

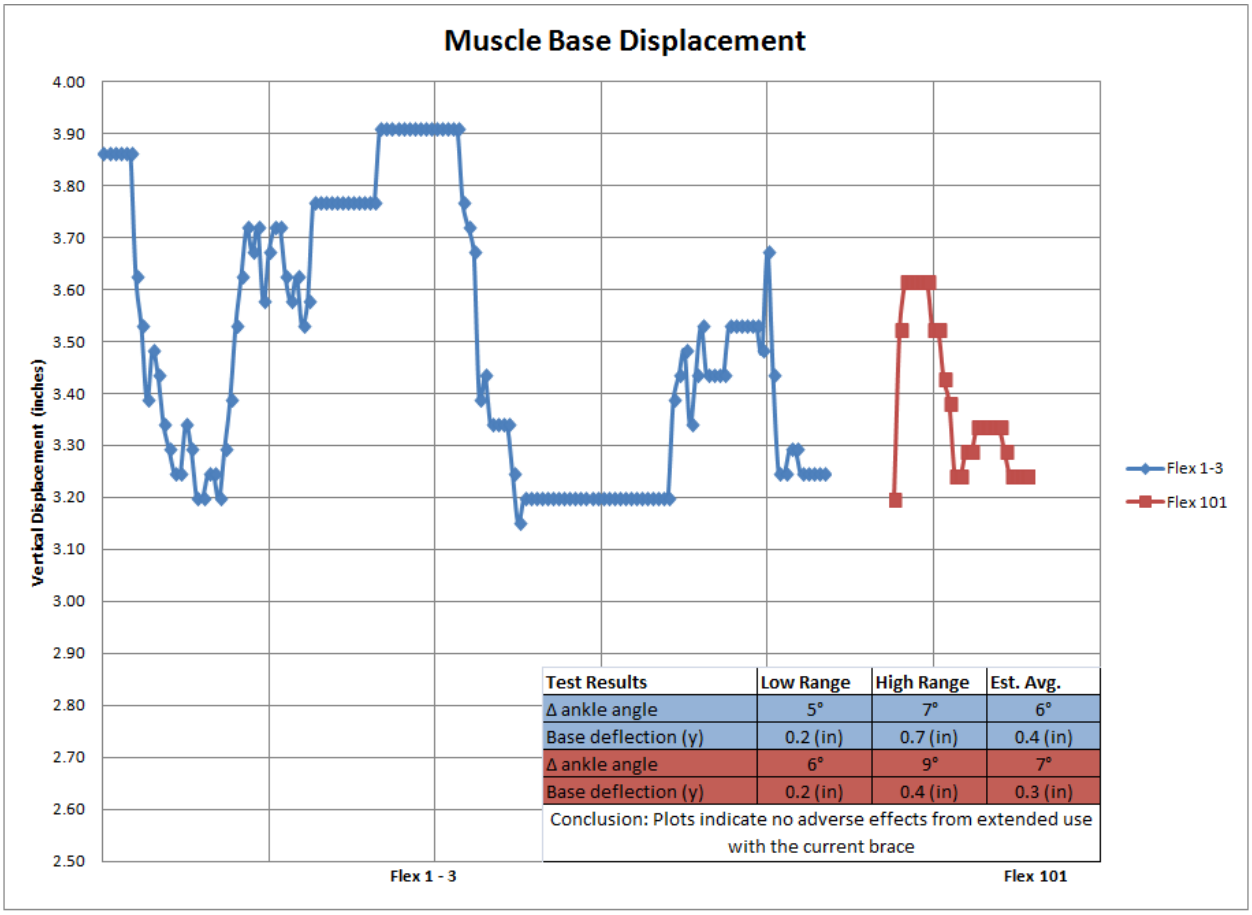

Figure 3: Muscle Base Displacement

Test Results	Low Range	High Range	Est. Avg.
Δ ankle angle	5°	7°	6°
Base deflection (y)	0.2 (in)	0.7 (in)	0.4 (in)
Δ ankle angle	6°	9°	7°
Base deflection (y)	0.2 (in)	0.4 (in)	0.3 (in)

Table 1: Extended use stage 1 results

The results of the ankle angle from the worst case scenario strain and the following foot lift test can be seen in Figure 4.

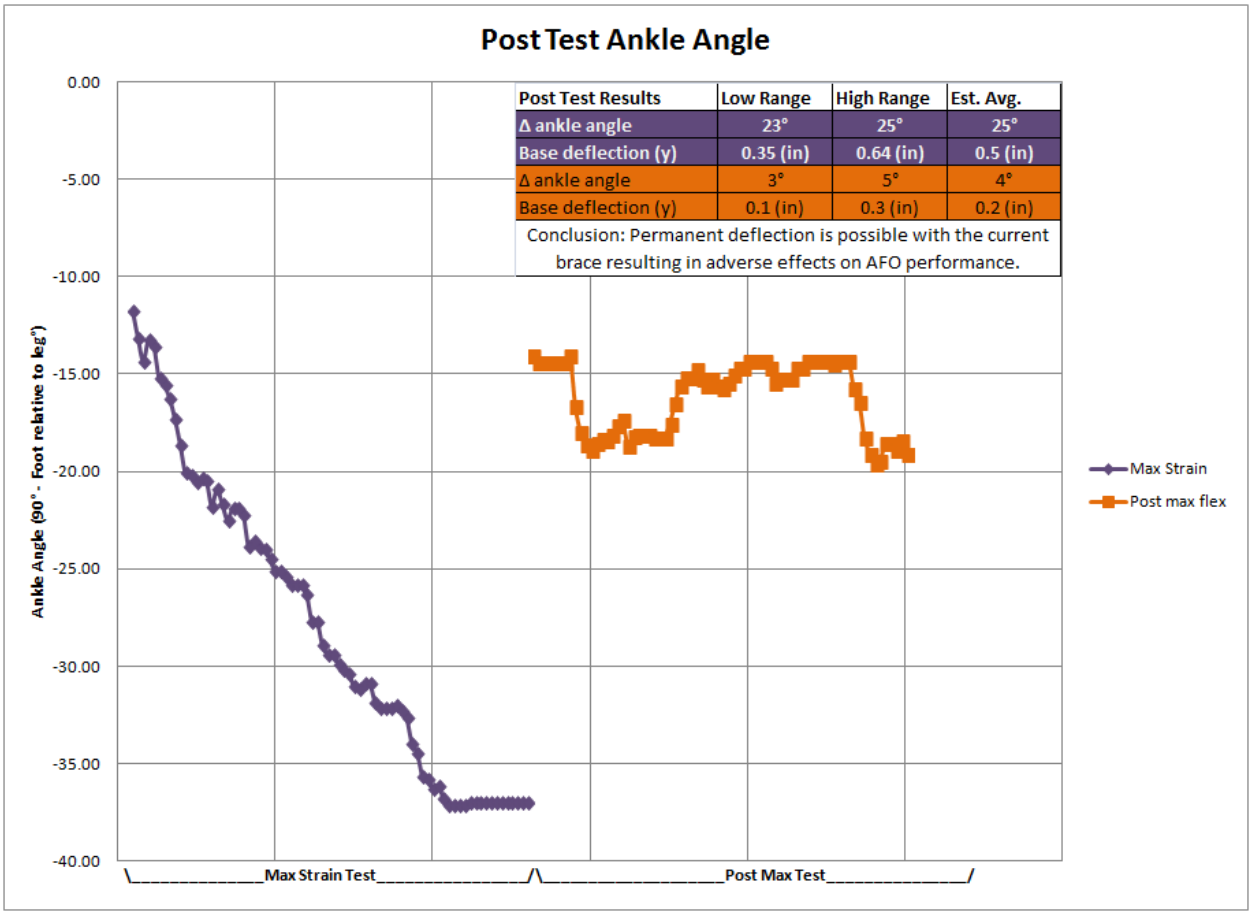

Figure 4: Ankle Angle Post Test

Similarly, the muscle base vertical displacement from the worst case scenario strain and the following foot lift test can be seen in Figure 5.

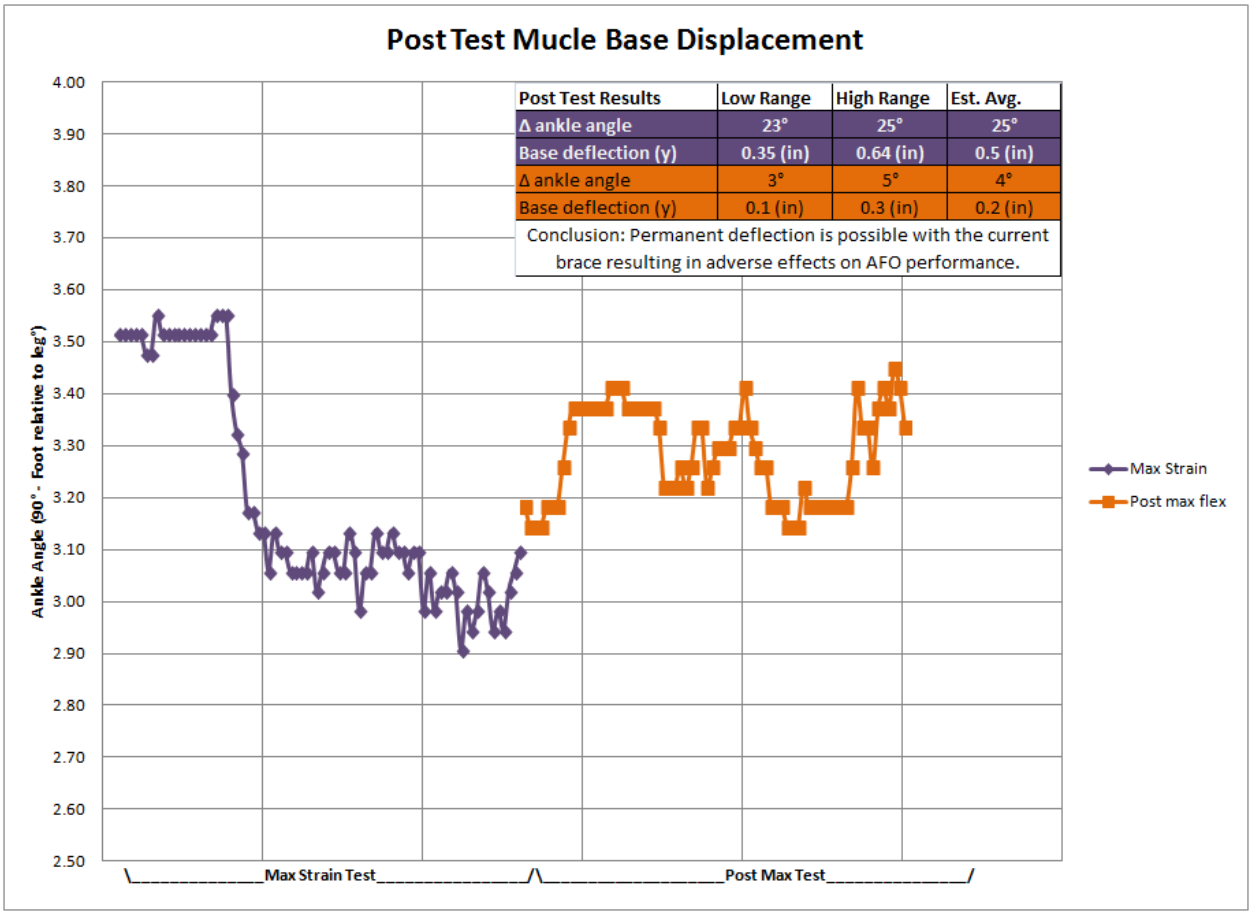

Figure 5: Muscle Base Displacement Post Test

Post Test Results	Low Range	High Range	Est. Avg.
Δ ankle angle	23°	25°	25°
Base deflection (y)	0.35 (in)	0.64 (in)	0.5 (in)
Δ ankle angle	3°	5°	4°
Base deflection (y)	0.1 (in)	0.3 (in)	0.2 (in)

Table 2: Post test results

Conclusions

The conclusions from this extended use stage 1 test and post test are that:
Test: Plots indicate no adverse effects from extended use with the current brace.
Post test: Permanent deflection is possible with the current brace resulting in adverse effects on AFO performance.

Next Steps

1. Implement upper brace redesign
2. Complete stage 2 testing