INTRODUCTION
When compared with other arthroplasties, Total Ankle Joint Replacement (TAR) is much less successful [1]. Attempts to remedy this situation by modifying the implant design, for example by making its form more akin to the original ankle anatomy, have largely met with failure. One of the major obstacles is a gap in current knowledge relating to ankle joint force. Specifically this is the lack of reliable data quantifying forces and moments acting on the ankle, in both the healthy and diseased joints. The limited data that does exist is thought to be inaccurate [1] and is based upon simplistic two dimensional discrete and outdated techniques.

METHODS
This paper reports a methodology to produce a three dimensional data for the forces acting on the ankle joints. Experimental walking gait data was collected with a modified Plug-in Gait model marker placement set with extra markers on the medial ankle, 1st and 5th metatarsals, using a 8 mm reflecting markers in the Vicon System. Data was captured with 120Hz MX cameras and sampled at a rate of 1024 Hz. Motion data were then filtered and cut to provide a unique complete gait cycle.

This data was then used to develop a dynamic musculoskeletal model in AnyBody. Based on the configuration of the new marker set, and the TLEM model consisting of 159 muscles in the lower limb (Figure 1), reaction forces acting within the ankle joint, forces acting on the Achilles tendon as well as forces from the tibialis anterior and peroneus were then calculated by the model using simple and complex recruitment solvers [3] for comparative purposes of the study.

RESULTS AND DISCUSSION
The results from three different trials were normalized and compared to data reported in the literature and found to be within an acceptable range of agreement (Table 1). The data was picked up based on the accuracy of the motion agreement. This data represents the gait of one subject (23 male, 80 kg) with 3 trials having a compressive peak value of 4250N and an average of 3962.5N at toe off.

Table 1: Comparison of Values for Forces about the Ankle Joint

<table>
<thead>
<tr>
<th>Forces</th>
<th>Arakilo</th>
<th>Stauffer et al.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Achilles Tendon Force</td>
<td>3.90BW±0.23</td>
<td>3.87BW</td>
</tr>
<tr>
<td>Compressive Force</td>
<td>4.95BW±0.21</td>
<td>4.73BW</td>
</tr>
<tr>
<td>Peroneus Force</td>
<td>0.615BW±0.03</td>
<td>NA</td>
</tr>
<tr>
<td>Tibialis Anterior Force</td>
<td>0.719BW±0.19</td>
<td>NA</td>
</tr>
</tbody>
</table>

The model strongly suggests that there is no need to develop a more complex model of the foot and also shows no difference between different muscles recruiters for assessing the forces acting on the ankle joint and surrounded muscles.

Plantarflexion originates from the Achilles tendon forces, which in this model, are determined completely by the ground reaction force and they are largely statically determinate in AnyBody.

CONCLUSION
TAR has been known for lack of reliability over the long term and questions have been raised regarding improving designs. This paper suggests a model of the distal tibia and the talus and the use of forces provided at a specific time of the gait cycle. Contact analysis could be run to evaluate the pressure and the stress on the contact area and to aid the optimisation of prosthesis design.

REFERENCES