INTRODUCTION

Sweat and heat are two major complaints in regards to socket comfort. Not only can these conditions cause discomfort, but they can lead to decreased skin health and maceration in some cases. The prosthetic socket, often coupled with a gel liner, acts as a thermal insulator. This compounds the problem of amputees having decreased skin surface area to dissipate heat, especially in the case of higher level or multi-limb loss cases. To address this problem, the team developed a process for fabricating a cushion liner that incorporates coolant tubes to reduce the temperature of the internal socket environment.

METHOD

The team developed a process for constructing a non-custom silicone cushion liner with coolant tubes imbedded 1-2 mm from the internal surface. Utilizing a reservoir of ice water and a pump, cold water was circulated through the liner. Two tests were performed, one with a bilateral trans-tibial amputee wearing a traditional liner on one limb, and the cooling liner on the other. The pump was cycled on and off while subject exercised at a self selected speed on an elliptical. Temperature data was collected for both liners utilizing temperature probes taped to the residual limb. The second test was performed with unilateral trans-tibial amputee, also exercising on an elliptical. Temperature measurements were taken with both a conventional liner and the cooling liner.

RESULTS

In both short term tests, the skin temperature dropped between 6-11% when the pump was cycled on. Both subjects stated that they felt a significant decrease in the temperature inside the socket when the pump was cycled on. Subjectively, the subjects also noted a decrease in sweat in liner upon removal. Both subjects stated that they would use the system under conditions when they might be hot (either from environmental temperatures or exercise).

DISCUSSION

The preliminary data and tests indicate that the system does result in a decrease in temperature that is noticeable by the user.

CONCLUSION

The system is proof of concept that a convective cooling system can effectively reduce temperatures in the socket, while not negatively impacting comfort, range of motion, or prosthetic suspension.

CLINICAL APPLICATIONS

Refinement of this system could lead to use in the general population, providing increased comfort, longer wear time, and decreased incidence of skin breakdown.