EFFECTIVENESS OF UNDERSHIRT FABRIC ON HARNESS COMFORT IN UPPER EXTREMITY PROSTHETIC USERS: A PILOT STUDY
Melanie S. Harris and Waldo O. Esparza, CP
Tampa Bay Prosthetics, Tampa, FL

ABSTRACT
This pilot study is to investigate alternatives to existing harness/skin interface for upper extremity amputees who use conventional or myoelectric prostheses with a harness. The study design is a single-system prospective study utilizing a population of convenience. A clinic population of upper limb amputees (trans-humeral, trans-radial and trans-carpal) from Tampa Bay Prosthetics and one associated with Northwestern University were included in the study. Participants were provided with two Jockey® Next-to-Nothing™ undershirts to wear as an interface between their harness and skin. They were asked to evaluate the new interface in comparison to their existing wearing pattern. Data for the study was collected using a self-reporting questionnaire that would be filled out after a predetermined wearing schedule. All of the participants were full-time upper extremity prosthetic users. Overall, results from the questionnaire indicates that the new textiles can positively impact the use of a harness in upper extremity prosthetic wearers

INTRODUCTION
The goal of the prosthetist for the upper extremity amputee is to enhance function, appearance, and to make activities of daily living (ADL) possible. Function is not a mechanism that can be measured exactly and is often in a state of flux and specific to the individual.

Both external- and body-powered upper extremity prosthetic users may or will require some type of harness. A harness for an upper extremity body-powered prosthesis has four main objectives: force transmission, suspension, comfort, and cosmesis [1]. Those fitted with body-powered prosthesis will require the use of a harness to aid in the suspension and control of the prosthesis in order to facilitate function of the limb. Often, those wearing a battery-powered or hybrid prosthesis will use a harness for suspension or control of one or more components of the prosthesis, such as the elbow or terminal device.

A variety of harness systems have been developed for specific amputation levels, activity levels and body makeup [2]. Generally, the more proximal the amputation, the more modifications and additions there are to the harness. Operating the prosthesis requires forces to be generated via the harness; this can initiate shear forces between the harness and the skin.

Comfort in the harness is necessary to facilitate maximum functional outcome and long-wearing time of the prosthesis [3,4], greatly impacting the ultimate usage of the prosthesis. Harness comfort was reported as one of the common prosthetic problems associated with prosthetic wear [5-10]. According to Datta et al. [11], as many as 33.75% of patients with proximal upper limb deficiency reject their prosthesis and many of those who continue to wear them do not find them useful in ADL. Abandoning the prosthesis is attributed to pain, weight, no functional benefit and poor cosmesis [11]. Schultz et al. surveyed opinions of prosthetists and other experts in the field to identify those factors that affect successful outcome for upper-extremity prosthetic users. The majority of the respondents considered comfort (socket interface and weight of prosthesis) as the most important factor for unilateral amputees [9]. Additional concerns included function (the most important for bilateral amputees), agility, power and, last, cosmesis [9]. We would like to further explore the relationship between harness comfort and acceptance and increased wearing time of the prostheses.
Traditionally, a cotton undershirt is worn as an interface between the patient’s skin and harness. The purpose is to provide comfort, an element of hygiene and to alleviate chafing during ADL. New “tactical” fabrics designed for the sporting industry are available that claim to possess moisture-wicking and friction-reducing capabilities and are breathable. These characteristics may improve harness comfort resulting in better functional outcome.

The intention for measuring functional outcome is to detect clinically important changes that have occurred in response to an intervention [12]. Specific functional outcome measures for adults who use upper extremity prosthetic devices are lacking in the literature [12]. Core measures are aimed at providing a comprehensive measure of different aspects of hand function and prosthetic use [12, 13, 14].

This paper presents an evidence-based single-system prospective study which draws from a population of convenience to evaluate harness comfort using a non-traditional interface. The study utilizes a trial wearing period of tactical fabrics followed by a self-assessment questionnaire used to determine if improved functional outcome can be achieved. Outcomes are measured with scores from quality of life indicators to demonstrate whether or not there is a benefit to wearing these new fabrics by evaluating comfort, moisture-wicking capabilities, friction reduction, and thermoregulation of the body. We devised to measure comfort levels for those patients that are both experienced and new prosthetic users.

Self reporting measures have the potential to be reliable, valid and responsive to change because they provide measures obtained from real world situations that may not be directly observable by a clinician [12].

METHODS

Review of medical records from Tampa Bay Prosthetics identified twenty patients who utilize a harness while wearing their upper-extremity prosthesis. In addition, requests were sent to Northwestern University to have any upper-extremity patients who use a harness and were interested in the study to contact our clinic in order to be included. Introductory letters were sent to all those identified as possible participants inviting them to join in the study. From the twenty patients contacted, nine from our clinic agreed to participate and one from Northwestern University wanted to be included. Information for this study was obtained from medical records, reports by patients, and from a questionnaire that was filled out after a two week wearing schedule of the undershirts provided to the participants. The questionnaire was developed by the author and not formally validated; however, the content was reviewed by colleagues and deemed appropriate for the study question. Additionally, an “Informed Consent” letter was sent to each participant that was to be signed and returned to the clinic.

We had contacted three manufacturers of performance-wear clothing that claim to produce materials that are superior to cotton for their moisture-wicking and friction-reducing capabilities to request donations of clothing for the study. Of those companies, Jockey® responded and provided us with 30 Next-to-Nothing™ undershirts of varying sizes. Two of these undershirts were provided to each participant along with a consent form and a self-administered questionnaire used to obtain data. The questionnaires were composed of 12 questions designed to collected data regarding the experience of using the study fabric as opposed to a cotton undershirt and how it affected comfort. Specific questions related to the moisture-wicking, breathability, and friction-reducing capabilities of the materials. The participants were asked about the type of interface that was normally worn between their harness and skin. Questions pertaining to amputation level and the type of prosthesis the patient wore (myoelectric, hybrid or conventional) were also included. Finally, the participants were asked if they would continue to
wear the study undershirts or go back to their normal routine. If the Jockey® undershirt was rejected at any time during the study, the questionnaire asked for the reason.

RESULTS

So far, Jockey® undershirts and questionnaires were sent to ten participants, of those, four (40%) returned the consent forms and followed-up with the questionnaires. All of the questions were completed in each of the returned questionnaires; these are summarized below.

Demographic details,

Half of the participants in the study had amputations at the transhumeral level and half had amputations at the transradial level.

Prosthetic Usage

Of the patients who returned the questionnaire, two used both conventional and battery-operated prostheses, one used a hybrid and one used conventional only. All of the respondents who participated are full-time prosthetic wearers.

Interface

Of the four respondents, three usually wore a 100% cotton undershirt as an interface between their harness and skin. Of these three, one would cut off the shirt above the waist for comfort. One patient was already wearing a similar undershirt. All respondents wore the Jockey® performance garments for the entire study period.

Comfort

The respondents were asked to rate the overall comfort of wearing the Jockey® undergarment compared to their normal routine. Three provided a response of “much more comfortable” and one responded “no difference”.

Breathability

All of the respondents found the Jockey® undergarment material felt more breathable than what they normally wore under their harness. Three found the test material “much more” breathable, while one found it “more breathable”. One respondent found the breathability to be the greatest improvement of the Jockey® garment over a cotton undershirt.

Moisture-wicking

The moisture-wicking capabilities of the Jockey® undergarment were also rated higher than cotton garments by all respondents. One patient did comment on the questionnaire that this ability caused his outer shirt to become moist, so, this may have actually been a point against the new material’s moisture-wicking capabilities as compared to his cotton undershirt.

Friction-reducing

Patients were asked if there was any reduction in chaffing from the harness while wearing the Jockey® undergarment. Three responded that the friction-reducing capabilities were much greater with the Jockey® garment than with a cotton undershirt, while one responded that there was no difference between the two. Three of the respondents reported that friction-reducing capabilities were the greatest improvement provided while using the Jockey® undergarment.

Continued use

All of the patients reported that they would continue to use the Jockey® undergarment, or one of a similar material, in place of their cotton undershirt.

DISCUSSION

Only 40% of the subjects identified for the study responded with completed questionnaires, for a total of 4 respondents. Half of these have amputations at the transhumeral level and half have amputations at the transradial level. Two of the subjects use both an externally-powered and body-powered prosthesis, one used a hybrid and one uses a body-powered. All are full-time
users. All of the participants found the material in the Jockey® undergarment to provide some benefit over a 100% cotton undershirt; all stated that would continue to wear the newer interface. Active-wear or “tactical” clothing can positively impact performance in sports and hobbies. Through this study, we have shown that this type of clothing can affect the level of harness comfort for upper extremity prosthetic wearers. It is our hope that this clothing will influence wearing time for the upper extremity prosthetic community when worn as an interface between the harness and skin.

The weakness of this study is predominantly due to the small subject base and the lack of information regarding the respondents who were provided with the undershirts and did not respond; their input may influence the results significantly. It may be that these patients did not return the questionnaires because they discontinued wearing the undershirts, although there was a section on the questionnaire that addressed this issue. This study did provide insight into an inexpensive and readily available avenue for providing increased comfort for some upper-extremity prosthetic users.

Another population to study would be those with upper-limb loss who have rejected their prosthesis, or wear their prosthesis only periodically. We could determine if increased harness comfort would have any impact on their decision to wear their prosthesis.

One method for collecting data could be a web-based, direct-access questionnaire as described by Wright [12] that can facilitate patient completion. The use of a larger network of patients is necessary to incorporate a larger population in order to better determine the effectiveness on new interfaces on comfort aspects associated with the harness.

REFERENCES