THE PROSTHETICS NEEDS OF FARMERS AND RANCHERS WITH UPPER-LIMB AMPUTATIONS

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INTRODUCTION

Farming and ranching are among the most hazardous occupations in the United States with many non-fatal accidents resulting in amputation [1], [2]. In addition, those who continue to farm using prostheses are at risk of secondary injuries related to the prosthesis, such as falls, entanglement, and overuse injuries to the intact limb [3]. Furthermore, the hazards of the farm environment are not limited to affecting the adult farmer, but also lead to a higher incidence of amputation among children of farmers than is experienced in children of the general population [4].

Many advances have been made in prosthetics technology since the 1970s, especially with regard to lower-limb prostheses and electric-powered upper-limb prostheses. However, in 2008, the National Institute on Disability and Rehabilitation Research (NIDRR) identified farmers as an underserved population with respect to assistive technology including prosthetics [5]. In response, the Northwestern University Prosthetics-Orthotics Center (NUPOC), as the NIDRR-funded Rehabilitation Engineering Research Center in Prosthetics and Orthotics, partnered with the National AgrAbility Project [6], a program of the U.S. Dept. of Agriculture that provides support services to farmers and ranchers with disabilities, to improve prosthetics options available to farmers and ranchers. The goals of this collaborative project include identification of activities supported by or hindered by use of a prosthesis, provide prosthetics-related educational materials to farmers and ranchers and to the prosthetists who serve them, and to improve prosthetics technology through analysis of failed components and engineering development projects. The project has completed the first phase of a two-part survey of farmers, ranchers, and prosthetists.

METHOD

The first part of the two-part survey was a series of interviews, by phone and in person, to determine specific problems encountered by farmers and ranchers with amputations who were either using prostheses or wanting to use prostheses to enhance their work. Interviews were conducted with 23 individuals with lower-limb amputations, 17 individuals with upper-limb amputations, and 25 prosthetists (across 14 states) who serve farmers and ranchers with amputations. Questions asked of the farmers and ranchers included information about the type and cause of the amputation, type of prosthesis currently being used and history of prosthesis use, types of prosthesis failures or problems experienced, other medical problems and secondary injuries, resources for purchase of prostheses, types of improvements desired, and comments on prosthetics service.

RESULTS

Of the 17 farmers with upper-limb amputations, one had a partial hand amputation, one had a wrist disarticulation, ten had transradial amputations (two bilateral), four had transhumeral amputations (one bilateral), and two had shoulder disarticulations. Thirteen of the farmers had amputations resulting from accidents involving farm equipment.

All of the farmers with amputations distal to the elbow were using a prosthesis at the time of the interview or used a prosthesis for farming before retiring. Only one (transhumeral level) of the six farmers with amputations proximal to the elbow was using a prosthesis at the time of the interview although most had briefly tried using a prosthesis in the early years after their amputation. All of the farmers who use or used a prosthesis in their farm work use cable-actuated body-powered devices. Seven of the farmers had experience with myoelectrically-controlled electric-powered devices but did not utilize them in their farming activities.

Figure 1: Farmer’s body-powered transradial prosthesis

The typical prosthesis for a farmer with a transradial amputation (see Figure 1) incorporated a Dorrance #7 Work Hook, a friction or quick-disconnect wrist, a laminated...
forearm with laminated or pulled-plastic socket, fabric or rigid hinges, an upper-arm cuff, a figure-of-eight harness of Dacron webbing, and heavy-duty steel cable. One farmer used a TRS GRIP device and one farmer used a polyethylene cable.

**DISCUSSION**

Farming remains hard work even in the age of mechanized farming and push-button combines. Several farmers described routinely picking up 50 and 100 pound (23 and 45 kg) sacks, climbing silos, handling livestock, connecting and disconnecting farm implements, and numerous maintenance chores.

The number one problem identified by both farmers and prosthetists was durability. Even though prosthetists considered the parts and construction used to be the most appropriate for heavy-duty use, not one farmer thought the devices were durable enough. Common problems mentioned included rapid deterioration of rubber bands due to sunlight, heat and chemicals, failure of wrist units, loosening of the hook from the wrist, breaks in the control cable or pulling of the cable from the fittings, and cracks in the lamination. Most farmers did their own mechanical repairs, and many did not have a back-up prosthesis because of insurance and cost constraints. Concern about durability was the most common reason cited for not using an electric-powered device for farm work, and it is difficult to imagine what kind of repairs a farmer might attempt if a contemporary myoelectric system stopped working.

In addition to the wear and tear of farm work, the farm environment places extraordinary demands on prosthesis performance and construction, including exposure to:

- a wide temperature range
- corrosive or damaging liquids
- airborne particulates
- biological and chemical contaminants

Several farmers mentioned washing the entire prosthesis with soap and hot water to remove dirt and contaminants, a process that would clearly be detrimental to an electric-powered system.

**CONCLUSIONS**

The interviews are being used to develop a paper and online survey to be administered to a broader representation of farmers and ranchers and prosthetists who serve them. The results of the interviews and broader survey will be used to develop educational materials to support best practices in implementing prostheses for farmers and ranchers and to identify engineering projects to improve component design and construction.

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**REFERENCES**