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13. Abstract ***(Maximum 200 Words)*** *(abstract should contain no proprietary or confidential information)*

The goals of this project are: 1) to study the temporal relationship between activity level and health status in polio survivors and to compare the results with those obtained from an age-matched control population and 2) to look at the effect of localized muscle weakness and the associated compensation response on performance of a walking task. Simulation modeling techniques will be used to identify factors critical to task performance, which will provide valuable information for optimizing rehabilitation interventions for polio survivors and other populations with lower extremity muscle weakness. To date, all project staff have been hired and trained. Initiation of human subjects testing for this study was delayed due to concerns on the part of AEHN administration about the language in the grant agreement regarding responsibility for research-related injuries. This dilemma has since been resolved and data collection is being initiated. A total of 90 polio survivors and 62 controls have been recruited and screened for Study #1. Preliminary simulations for Study #2 have been run on the biomechanical model to understand baseline performance and to document information flow. The results for the sensitivity analysis are being analyzed and the model validation process has begun.

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INTRODUCTION

Controversy exists regarding the relationship between strength, functional performance and health status in the post-polio population and the role of activity level in this relationship. Polio survivors tend to have a higher incidence of muscle and joint pain and higher levels of fatigue after normal daily activity compared to the general population. One possible explanation is that, because of their residual muscle weakness, polio survivors perform their activities at a higher activity intensity level than their peers that may, in turn, make them more susceptible to musculoskeletal problems. However, there have not been any systematic studies performed to confirm this theory. Therefore, one of the goals of this project is to study the temporal relationship between activity level and health status in polio survivors and to compare the results with those obtained from an age-matched control population. A need also exists for improved neuromuscular, musculoskeletal, and link segment dynamic models of common daily activities that can be used to predict the compensatory strategies that will be employed when muscle weakness is present. Therefore, another goal of this research is to look at the effect of localized muscle weakness and the associated compensation response on performance of a walking task. Simulation modeling techniques will be used to identify factors critical to task performance, which will provide valuable information for optimizing rehabilitation interventions for polio survivors and other populations with lower extremity muscle weakness.

BODY

Study #1: An Analysis of Health Status and Activity Level in Polio Survivors Over Time

Within the first quarter, all project staff were trained and data collection protocols were finalized. Data collection forms were developed, tested and modified for appropriateness and usability. Modifications were made to the forms to accommodate testing order and to enhance efficiency during testing. A weekly testing schedule was also developed to optimize the use of the clinicians' time. The project database that will be used for storing subject information, symptom data, strength, and activity results has been designed and is ready for implementation. Queries have been written to allow for automatic calculation of summary statistics related to lower extremity performance scores, activity levels, pain ratings and disability scores.

The inclusion and exclusion criteria were operationalized and specific plans for subject recruitment were developed. Due to the diverse subject population required for this study, we identified a wide variety of potential recruitment sources, including local newspapers, polio network and support groups newsletters, Premier Years newsletter (distributed to local seniors by the hospital network), and the Polio Connection website. Handouts are being developed and will be distributed to various churches, VFWs, and senior centers in the area. A letter summarizing the inclusion and exclusion criteria and study protocol will also be sent to local gerontologists and family practice physicians asking for their help in recruiting potential subjects.

Although the funding for this study was approved in Sept. 2001, negotiations between the administration for the Albert Einstein Healthcare Network and the contracting office for the Department of the Army regarding language included in the grant agreement resulted in a delay in the signing of the final contract to be held up until mid-Sept. 2002. As a result, no human

subjects testing could be done this past year, and no data was available for analysis. Now, with resolution of the contract issues, we plan to begin data collection as soon as possible. To date, a total of 90 polio survivors and 62 controls have been recruited and screened for this study.

Study #2 Development of a Walking Model for Simulating the Effect of Localized Muscle Weakness

The staff for this study was hired and trained in the first quarter of this grant, and the data collection protocol was finalized. Computers, software, and other technical resources necessary to begin work on this study were obtained. A minimal test computer system was borrowed from the hospital's computer support department. This platform was assembled to assess software functionality and performance. Once system (i.e. software and computer) performance has been fully understood and documented, the computer system specified in the budget will be purchased.

Delivery of the custom software, which included the biomechanical model needed for this study, was initially delayed due to technical issues on the vendor side. Subsequent vendor business issues produced additional delays in delivery of the specified software codes necessary to begin the engineering analyses. The vendor (MDI Inc.) was acquired by another software company, MSC Software. In the process, the consultant and author of the software left MDI. As a result, the final working codes for the biomechanical model were not delivered until the end of May 2002.

In the past year, the staff has gained considerable familiarity with all software required for this study, including the Adams, Matlab, Simulink, and biomechanical model platforms. Custom codes have been written to allow data transfer between the existing data collection system and the modeling software. Preliminary simulations have been run on the baseline model to understand baseline performance and to document information flow. A master flowchart has been created to document coordination of information within the model. This chart details how specific information is computed at various locations (model subunits) and how data are distributed or routed through the model.

The existing foot-ground interaction of the baseline model and possible alternatives have been studied. The existing foot-ground interaction was determined to be adequate for the present level of analysis. When subsequent intersegmental dynamics analysis (IDA) simulations are performed, it may be necessary to modify the foot model. The evaluations done in the first year should expedite that process, should it prove necessary.

A sensitivity analysis has been performed to test the limits of model stability and sensitivity of model performance to various operating parameters. The results are presently being interpreted to understand the performance and similarity of the model to the human neuromuscular system it is designed to emulate.

Model validation is currently underway. The ultimate result of the validation process will be an assessment of how similarly the model responds to changes that are used to represent the results of pathology (i.e. muscle weakness). The weakness deficits database has not yet been calculated

due to delays in obtaining the software. Eventually, this database will serve as a measure of the uncompensated effect of a single joint (muscle group) weakness.

As noted under Study #1, final approval of the contract giving permission for human subjects testing was not received until Sept. 12, 2002. Therefore, there has not been any subject recruitment and/or data collection conducted so far for this study.

KEY RESEARCH ACCOMPLISHMENTS:

- All project staff have been hired and trained.
- A total of 90 polio survivors and 62 controls have been recruited and screened for Study #1.
- Preliminary simulations for Study #2 have been run on the biomechanical model to understand baseline performance and to document information flow. The results for the sensitivity analysis are being analyzed and the model validation process has begun.

REPORTABLE OUTCOMES:

Since data collection had not yet begun as of Sept. 15, 2002, there were no reportable outcomes.

CONCLUSIONS:

This section is not applicable at this time.