A Nurse-Coached Program of Exercise to Increase Muscle Strength, Improve Quality of Life, and Increase Self-Efficacy in People with Tetraplegic Spinal Cord Injuries

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Problem Statement

- Spinal cord injury rehabilitation has traditionally focused on compensating for losses due to the injury.

- People with tetraplegic spinal cord injuries have very limited opportunities for any types of accessible exercise programs designed to promote continued recovery and wellness.
Background

- 17,000 people suffer SCI in the US/year
  - 12,000 survive to reach the hospital
- Between 250,000 and 400,000 people are living with SCI in the US
- Median age at time of injury is 26 years
  - Highest incidence is in 19 year olds

SCI Information Network, 2008
Secondary Complications of SCI Due to Immobility

- Urinary Tract Infections
- Pneumonia
- Pressure sores → sepsis
- DVT → pulmonary emboli
- Decreased cardiovascular function
- Muscle atrophy
- Bone loss
- Depression
Statement of Study Purpose

To determine the effects of a nurse-coached exercise program for people with tetraplegic SCI on:

- Muscle strength
- Quality of life
- Self-efficacy
Pilot Study 2003-2004
“The First Five Project”

A Qualitative Study

- 5 participants - all tetraplegic SCI
- 6 month program designed to teach them a home exercise regime
Major Findings

- Participants wanted to exercise together
  - They encouraged each other
  - They learned from each other
- Complications decreased
  - No UTIs, decreased spasticity, better sleep, less shoulder pain, more energy, increased enthusiasm
- Improved function
  - Observed and reported self-care and mobility improvements
- Family stress reduced
  - Glad their loved one was getting out of the house and doing “something healthy”
  - Reported positive changes in “attitude”
Development of the Model

The Spinal Cord Injury Functional Improvement Via Exercise Model (SCI-FIVE)
SPINAL CORD
INJURED PERSON

Sheehy
SCI-FIVE
Model
SPINAL CORD INJURED PERSON

Community Environment

Sheehy SCI-FIVE Model

Nurse-Coached Exercise Program
SPINAL CORD INJURED PERSON

Community Environment

Group Encouragement

Nurse-Coached Exercise Program

Sheehy SCI-FIVE Model

Vicarious Learning
SPINAL CORD INJURED PERSON

Community Environment

Nurse-Coached Exercise Program

Increased Muscle Strength

Group Encouragement

Vicarious Learning

Sheehy SCI-FIVE Model
SPINAL CORD INJURED PERSON

- Nurse-Coached Exercise Program
- Group Encouragement
- Vicarious Learning

Community Environment
- Increased Function
- Increased Endurance
- Muscle Strength

Sheehy SCI-FIVE Model
SPINAL CORD INJURED PERSON

- Nurse-Coached Exercise Program
  - Increased Function
  - Increased Endurance
  - Increased Independence
- Community Environment
  - Increased Function
  - Increased Endurance
  - Increased Independence
  - Muscle Strength
  - Group Encouragement
- Vicarious Learning

Sheehy SCI-FIVE Model
SPINAL CORD INJURED PERSON

Increase Independence
Increase Self-Efficacy
Increase Endurance
Increase Function
Increase Muscle Strength

Community Environment

Nurse-Coached Exercise Program

Sheehy SCI-FIVE Model

Group Encouragement
Vicarious Learning
SPINAL CORD INJURED PERSON

- Nurse-Coached Exercise Program
- Community Environment

Increased Function
Increased Endurance
Increased Self-Efficacy
Increased Independence
Increased Muscle Strength

Higher Quality of Life

Sheehy SCI-FIVE Model

Group Encouragement
Vicarious Learning
Statement of Significance

The direction of this research can potentially

- Improve quality of life for people with spinal cord injuries and their family members
- Inform rehabilitation practitioners
  - Change how goals are set for people with SCI
- Foster a more equitable society; access to exercise
- Reduce cost of post-SCI secondary complications
## Study Participants

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<tr>
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<th>Level</th>
<th>Comp/In comp</th>
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<td>47</td>
<td>F</td>
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Measurement Instruments

Manual Muscle Test (MMT)
- Muscle strength rated from 0 (no movement) to 5 (normal movement)

Catz-Itzkovich Spinal Cord Independence Measures (CI-SCIM)
- 18 items in 3 categories (various values)
  - Self Care, Respiratory and Sphincter, Mobility

Moorong Self-Efficacy Score (MSES)
- 16 items (7-point Likert Scale)
Procedures

Recruitment
- Self referral, peer referral, hospital/professional referral

Baseline Testing
- X2 – MMT, CI-SCIM, MSES

Time
- 3 hours/day, 3 days/week, over 6 months

Exercises
- Standing frame, Vita Glide, Nu-Step, FES Bike, Mat

Intervention Testing
- At 3 months and 6 months
Exercise Equipment

Vita Glide ® (RTM Fitness)

Easy Stand Evolv Glider® (Altimate Corporation)

The NuStep TRS 4000 Recumbent Cross Trainer ® (NuStep)

RTS 300-S FES Bike® (Restorative Therapies Technologies, Inc.)
Research Method

Single Subject Design

- Ten participants
  An N of 1, 10 times
- Multiple Baseline Across Subjects Design
  A type A-B design
  A = Baseline/non-intervention phase
  B = Intervention phase
Assumption in A-B Design

If not for the intervention, observations made in baseline would likely continue in the same pattern.
Design and Analysis

Single Subject Design

- Visual analysis of graph slope trends

![Graph illustrating single subject design with baseline and intervention phases, showing conditions for improvement, no change, and deterioration.](image)
Compliance with Ethical Guidelines

- IRB approval (Hospital and University)
- Informed consent
- Voluntary participation
- Confidentiality
  - No names on records
  - Numeric codes assigned to each participant
  - Data stored in secured/locked home office
Manual Muscle Test Graphs

Figure 4.9a  Participant #1 Posterior Deltoid - Left

Figure 4.22a  Participant #2 Anterior Deltoid - Left

Figure 4.30a  Participant #3 Rhomboids - Left

Figure 4.52a  Participant #4 Flexor Carpi Radialis - Left

MMT Scores
<table>
<thead>
<tr>
<th>Participant #</th>
<th>Total # Muscles Tested</th>
<th># Decreased</th>
<th># Improved</th>
<th>% Improved</th>
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<td>22</td>
<td>58%</td>
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<td>4</td>
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<td>8</td>
<td>67%</td>
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<td>18</td>
<td>0</td>
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Muscle Test Results

A total of 224 muscles were tested

- 30 - normal at baseline
- 144 - some strength at baseline
  - 108 (75%) demonstrated increased strength at 3 and/or 6 months
- 50 - no strength at baseline
  - 66% adjacent to muscles with some strength demonstrated increased strength at 3 and/or 6 months
CI-SCIM (Quality of Life) Results

Self-Care – Participant #6

Respiratory & Sphincter – Participant #6

Mobility – Participant #6
### QOL by Sub-Scale

#### Self Care

<table>
<thead>
<tr>
<th>Participant</th>
<th>Baseline Score</th>
<th>Baseline to 3 months Improvement</th>
<th>3 months to 6 months Improvement</th>
<th>Baseline to 6 months Score</th>
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## QOL by Sub-Scale
### Respiratory and Sphincter

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<th>3 months to 6 months Improvement</th>
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# QOL by Sub-Scale

**Mobility**

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CI-SCIM Results

- QOL measures improved or strongly improved in 9 of 10 participants from baseline to 3-months and 3-months to 6 months:
  - Overall composite
  - Self-Care
  - Mobility
- There was no significant improvement in:
  - Respiratory and Sphincter
Moorong Self-Efficacy Score Results
<table>
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<th>3 mo → 6 mo</th>
<th>BL → 6mo</th>
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</table>
MSES Results

Moorong Self-Efficacy Scores strongly improved in each of the ten participants from baseline to 3-months and 3-months to 6 months
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<th>Notes</th>
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</thead>
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<td>20F</td>
<td>Returned to college – changed major to social work; Retrofitted horse buggy so she could continue to ride horses</td>
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<tr>
<td>2</td>
<td>20F</td>
<td>Not heard from after study</td>
</tr>
<tr>
<td>3</td>
<td>27M</td>
<td>Started dating; married; moved to warmer climate; became politically active in disability issues; working full time</td>
</tr>
<tr>
<td>4</td>
<td>23F</td>
<td>Learned to self-cath; moved out of abusive home; moved to warmer climate; started college</td>
</tr>
<tr>
<td>5</td>
<td>27M</td>
<td>Started dating; married; moved to warmer climate; working full time; expecting first baby</td>
</tr>
<tr>
<td>6</td>
<td>20M</td>
<td>Finished college; married; moved to CA; began professional acting/singing career</td>
</tr>
<tr>
<td>7</td>
<td>26M</td>
<td>Married; had a baby; returned to school for MBA; working full time</td>
</tr>
<tr>
<td>8</td>
<td>39M</td>
<td>Started taking college courses; wants to be a history teacher; works part time.</td>
</tr>
<tr>
<td>9</td>
<td>29M</td>
<td>Was a manual laborer; went to work full time at a college admissions office (job suggested by program volunteer); started college part time; husband and father of two</td>
</tr>
<tr>
<td>10</td>
<td>41F</td>
<td>Very active prior to study; continues activities – teaches high school, scuba dives, cooks for friends; SCI advocate/role model for others in study</td>
</tr>
</tbody>
</table>
Results Summary

This nurse-coached exercise program for people with tetraplegic spinal cord injuries resulted in significant gains in:

- Muscle strength (RQ1)
- Quality of Life (CI-SCIM) (RQ2)
  - Self Care and Mobility
  - Not for respiratory/sphincter
- Self-Efficacy/MSES (RQ3)
Strengths of The Study

- Multiple Baseline Single Subject Design
  - 10 replications
- Standardized clinical decision-making tools
- Independent evaluators for MMT
- The nurse/participant relationship was very strong
Limitations of This Study

- Sample size (although OK for single subject)
- Lack of geographical and ethnic diversity
  - Results may not be generalized to other populations
- No “official” long-term follow-up
- No control for Coach’s personal style
- Unable to determine which exercise or combination of exercises were more influential on results
Unique Contribution

The study was the first to

- link exercise and QOL in people with SCI
- link exercise and self-efficacy in people with SCI
- demonstrate that muscle strength can increase, quality of life can improve, and self-efficacy can increase significantly, long after outpatient rehabilitation times end
- demonstrate that people with SCI's that occurred many years prior can still benefit from such a program
Implications for Nursing

- Nurses have an important role to play in developing wellness and continuous improvement interventions for people with spinal cord injuries

- Nurses are ideally suited for this role – a holistic focus
  - Understand physiologic responses to this injury and exercise
  - Aware of psychosocial implications
  - Inherent trust factor
Implications for Practice

- Need to develop accessible and affordable programs that offer opportunities for continued improvements in health and quality of life for people with SCI

- Imperative that third party payers recognize the value of such programs and approve them as “covered costs”
Implications for Policy

- National Guidelines

- Fund programs that promote wellness, decrease complications, improve quality of life for people with SCI

- Fund research (SCI is an “orphan” condition with catastrophic consequences) regarding people living with SCI
Implications for Theory Development and Future Research

- Replication
- Longitudinal studies
- Larger sample size
- Expand measures
  - Track secondary complications of SCI (UTIs, pneumonias, pressure sores, DVTs/Pes), pain, sleep patterns, spasticity, work/school, families, longevity
  - Physiologic responses (cardiac, pulmonary, bone)
- Determine most effective exercises/equipment
- Determine cost effectiveness of program
- Expand the intervention to include other chronic CNS conditions (e.g., MS, stroke, TBI, ...
Conclusions

- A nurse-coached exercise program increased muscle strength, improved quality of life, and increased self-efficacy in ten people with tetraplegic SCI.
- Findings demonstrated that people with tetraplegic SCI can continue to recover some function long after their injury occurred.
- Findings validate the Sheehy SCI-FIVE Model and support the efficacy of the intervention.
Funding for this research was received from:

The Christopher Reeve Foundation
The Travis Roy Foundation
The Gustav and Louisa Pfeiffer Family Foundation
The Jack Shadduck Family
The Mark Lewis Fund
“Some choices will choose you. How you face these choices... is what will define the context of your life.”

Dana Reeve (1961-2006)

In memory of Dana and Christopher Reeve, Raul, and Dan
Thank you