An Evaluation of the Impact of Splinting on the Functional Independence and Quality of Life of Stroke Survivors

Roshni Khatri
Director of studies: Dr. Alexandra Lehner
1st supervisor: Associate Professor Antony Kay
2nd supervisor: Professor of Rehabilitation Research Pip Logan
Functional Impact of Stroke

• Upper Limb affected more than Lower Limb
• Loss of sensorimotor capacity in 60%
• Individuals with considerable motor loss in initial stages correlates with poor functional return in the upper limb.

(Sheehan, 2006)
Rehabilitation Approaches

- Bilateral training
- Constraint-induced movement therapy
- Electrical stimulation
- High-intensity therapy
- Repetitive task training
- Robotics
- Splinting.

(Langhorne, 2011)
What are splints used for?

- Reduce spasticity
- Prevent deformity
- Lengthen soft tissue
- Reduce or prevent contracture
- Prevent pain
- Improve function

(Kuipers, 2009; Adrienne and Manigandan, 2011; Kilbride et al., 2013)
Current Evidence supporting splinting in practice

- 2-3 hours of splinting for 3-4 months resulted in significant changes to spasticity (Ushiba et al., 2004; Suat et al., 2011; Pizzi et al., 2005)

- 8-6 hours for 2-3 months also showed significant reduction in spasticity following splinting (Bürge et al., 2008), (Abdovahab et al., 2010) and (Fujiwara et al., 2004)
Current Evidence challenging splinting in Practice

- Wearing splints for 1 - 1.5 months for 9-12 hours showed no significant effect on spasticity.
  (Lannin et al., 2007; Basaran et al., 2012; Andringa et al., 2013)

- No significant effect on PROM after long or short durations of splinting.
  (Lannin et al., 2003, Lannin et al., 2007; Basaran et al., 2012; Bürge et al., 2008)

- No significant effect on Functional Ability.
  (Lannin et al., 2003, Lannin et al., 2007; Bürge et al., 2008; Suat et al., 2011, Garros et al., 2010)
National Guidelines

• (NICE, 2013) suggest that wrist and hand splints are considered to maintain ROM and soft tissue length as part of the rehabilitation programme for stroke survivors.

• (RCP, 2012) in the National Clinical Guidelines for Stroke also suggest that splints may be a consideration when there is persistent spasticity and can be used with other treatment modalities e.g. botulin toxin therapy.
Research Methodology

- Study 1 – National Survey of splinting practice
- Study 2 – Experimental Case studies
- Study 3 – Explorative and Experimental Case studies

Ethics Approval was received from The University of Northampton, School of Health Ethics Committee.
Study 1

Objectives:

• Critically appraise current literature related to splinting and its impact on the upper limb, functional ability and quality of life for stroke survivors to inform the development of a questionnaire.

• To evaluate current occupational therapy practice in the area of splinting for stroke survivors to improve functional ability and quality of life.
World Health Organisation’s International Classification of Functioning, Disability and Health - A model for rehabilitation (WHO, 2002)
The design of this questionnaire is informed by the model presented in Radhakrishna (2007).
Key Findings
Study 1

• Findings similar to previous surveys (Adrienne and Manigandan, 2011; Kilbride et al., 2013).

• Context of practice – 69% work in rehabilitation setting

• 81% using splinting for stroke survivors – 43.5% (always splint)

• 49% use guidelines but majority of these are locally written guidelines

• Volar splint is most commonly used followed by the dorsal splint
Key Findings - Study 1

• Splinting is used as an adjunct rather than as a lone modality – >80%
• Aims are related to functional improvement but approach is impairment based – Aims vs. outcome measures used (Sivan et al., 2011)
• Practice wisdom – vital for future research (Paterson et al., 2006).
• Wide ranging and diverse approach to splinting
World Health Organisation’s International Classification of Functioning, Disability and Health

A Model for Rehabilitation

(WHO, 2002)
Health Condition
Stroke / Splinting

Body Functions and Body Structures (Impairment)
- MMAS
- Modified Ashworth Scale
- Tardieu Scale
- Modified Tardieu Scale
- The Jebsen Hand Function Test
- Fugl-Meyer motor assessment
- The Disabilities of the Arm, Shoulder and Hand (DASH)
- Motricity index of arm and leg
- Motor assessment scale
- Action research arm test
- The box and Block Test
- Chedoke Arm and hand Activity Inventory (CAHAI)
- The Nine Hole Peg Test (NHPT)
- The Wolf Motor Function Test (WMFT)

Activities (Limitation)
- Functional independence measure
- Frenchay activities index
- Modified Rankin scale
- Rivermead mobility index
- Frenchay arm test
- Wolf motor function test
- A-one
- AMPS
- Barthel Index
- Chedoke-McMaster Stroke Assessment
- The Rivermead Mobility Index (RMI)
- Nottingham extended activities of daily living

Participation (Restriction)
- Euroqol-5D
- Nottingham health profile
- General health questionnaire
- Stroke impact profile (stroke adapted version)
- Medical outcome study short form 36
- Stroke-specific quality of life (SSQoL)
- The Reintegration to Normal Living Index (RNLI)

Environmental Factors

Personal Factors

COSMIN (COnsensus-based Standards for the selection of health Measurement INstruments)
Study 2

Design

Findings from Study 1 used to structure Study 2 – using OM’s for all ICF categories.

- PROM – Passive Range of Motion
- AROM – Active Range of Motion
- MAS – Modified Ashworth Scale
- EMG - Electromyography
- FMATM – Fugl Myer Total Motor
- SSQoL – Stroke Specific Quality of Life
- BI – Barthel Index

Reliability tests showed that constructs of each of the measures were compatible.
<table>
<thead>
<tr>
<th>Gender</th>
<th>Age Mean:</th>
<th>Time since Stroke Mean:</th>
<th>Splint</th>
<th>Splint Hours ave/wk Mean:</th>
<th>Day/night use</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>46.5 SD: 17.8</td>
<td>6.75 SD: 7.32</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Male</td>
<td>68</td>
<td>2 years</td>
<td>Volar</td>
<td>5</td>
<td>Day</td>
</tr>
<tr>
<td>2. Male</td>
<td>67</td>
<td>4 years</td>
<td>Volar</td>
<td>5</td>
<td>Day</td>
</tr>
<tr>
<td>3. Male</td>
<td>32</td>
<td>5 years</td>
<td>Dorsal</td>
<td>8</td>
<td>Day</td>
</tr>
<tr>
<td>4. Male</td>
<td>56</td>
<td>3 years</td>
<td>Dorsal</td>
<td>4</td>
<td>Day</td>
</tr>
<tr>
<td>5. Female</td>
<td>23</td>
<td>2 years</td>
<td>Dorsal</td>
<td>8</td>
<td>Day</td>
</tr>
<tr>
<td>6. Male</td>
<td>56</td>
<td>12 years</td>
<td>Dorsal</td>
<td>2</td>
<td>Day</td>
</tr>
<tr>
<td>7. Female</td>
<td>43</td>
<td>23 years</td>
<td>Volar</td>
<td>4</td>
<td>Day</td>
</tr>
<tr>
<td>8. Male</td>
<td>27</td>
<td>3 years</td>
<td>Volar</td>
<td>4</td>
<td>Day</td>
</tr>
</tbody>
</table>
Key Findings – Study 2

• No significant difference between the volar and dorsal group but non-parametric analysis of ranked scores showed marginally higher scores in the dorsal group (Basaran et al., 2012; Field, 2013).

• Motor function, Functional ability and quality of life changed significantly from baseline to 8 weeks with large effect sizes.

• Changes in PROM of elbow flexion after 6 weeks and significantly associated with BI and FMA-TM scores (Pizzi et al., 2005; Abdolvahab et al., 2010; Amini et al., 2014).
Key Findings – Study 2

- PROM of the elbow is significantly associated with MAS (de Jong et al., 2007).
- Changes in MAS significant after 2 – 4 weeks (Pizzi et al., 2005; Sheehan et al., 2006).
- MAS significantly associated with FMA-TM scores (Kawashima et al., 2010).
- Correlation between MAS and EMG (Naghdi et al., 2010; Crow and Harmeling-van der Wel, 2008).
- Max EMG of biceps and triceps increased (Kawashima et al., 2010; Lum et al., 2009).
Key Findings - Study 2

Therefore:
• ICF provides an effective framework
• Improvement in Sensorimotor components have the potential to effect Function and QoL.
• Dorsal Splints require further investigation.
Study 3

- Exploratory and experimental Case study design

**Study Objectives:**
- Establish the physical outcomes following a 6 month splinting programme for the management of the upper limb of stroke survivors
- Establish the functional outcomes following a 6 month splinting programme for the management of the upper limb of stroke survivors
- To evaluate the long-term effects of splinting.

Outcomes Measures Completed (weeks):
- PROM 8, 24
- AROM 8, 24
- MAS 8, 24
- EMG 8, 24
- FMA-UE 8, 24
- BI 8, 24
- SSQOL 8, 24

Mann Whitney Wilcoxon Spearman’s
Key Findings – Study 3

• Only two studies have investigated the long term effects of splinting – Function (Andringa et al., 2013; Suat et al., 2011).

• 5 of the 6 Participants chose to continued to wear their splints – Compliance (Garros et al., 2010; Kuipersa et al., 2009).

• 1 participant stopped wearing her splint – New job!

• No Statistical difference between volar and dorsal splints but median scores still marginally higher in dorsal group.

• MAS remained unchanged, EMG increased marginally for 3 of the 5 participants.

• MAS, motor function, functional capacity and quality of life continued to improve for 3 of the 5 participants.
Key Findings – Study 3

Participant 5

Participant 6
Interviews

- ‘I can stand better now since I started wearing the splint’
- ‘I used to take my dogs for a short walk but I can walk for 30-40 mins now because I can hold the leads’
- ‘I can take my hand behind my back now ... after 3 years’
Recommendations

- Implementation of ICF to guide splinting practice
- Pilot implementation and evaluation of ICF Checklist for Upper Limb Splinting addressing all categories of rehabilitation model
- Conduct RCT’s to investigate the combination of test measures used.
- Further investigation of the use of the dorsal splint.
- Development of a mobile application that incorporates the above.
References


• NICE (2013) *Stroke Rehabilitation - Long term rehabilitation after stroke*.


Thank you for listening

Written and presented by Roshni Khatri

Contact: roshni.khatri@northampton.ac.uk