

Synapse

OFFICIAL JOURNAL OF THE **ASSOCIATION OF CHARTERED PHYSIOTHERAPISTS IN NEUROLOGY**

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**Combined
physiotherapy
and occupational
therapy management
of neurological
shoulder subluxation
in SCI: a single case
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the NNR/ACPIN
conference in
Maastricht**

Editorial

Synapse

AUGUST 2019



Dear members,

A warm welcome to our peer-reviewed journal, *Synapse*.

Special features of this edition includes an article on combined physiotherapy and occupational therapy management of neurological shoulder subluxation in Spinal Cord Injury and abstracts from the joint NNR/ACPIN conference held in Maastricht from the 24th to the 26th May 2019.

If you are interested in submitting your work for publication in *Synapse*, please follow the guidelines at the end of this issue and send your work for inclusion in the peer-review process.

We look forward to receiving high quality work for publication in *Synapse*.



Dr Praveen Kumar
EDITOR

Key aspects to *Synapse*'s publication and dissemination strategy are :

1. To provide a platform for publication of high quality research studies.
2. To provide peer-review feedback for novice researchers.
3. To have special/ supplementary editions on specific topics/areas/student related projects.
4. To have a clearly defined editorial board.
5. To have a review board that includes both national and international reviewers. (This includes academics, researchers, clinicians, ACPIN members, non-ACPIN members/experts in the field of neurology/neurological rehabilitation, physical medicine and rehabilitation).



Synapse

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Combined physiotherapy and occupational therapy management of neurological shoulder subluxation in Spinal Cord Injury (SCI): a single case study

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The shoulder complex consists of four separate joints, providing it with mobility, often at the expense of stability (Paci *et al* 2007). Injury or paralysis of muscles around the shoulder complex often leads to glenohumeral joint subluxation (Fil *et al* 2011).

A systematic review of rehabilitation methods for reducing shoulder subluxation post stroke was published in 2017 (Arya *et al*). 717 studies were identified with 22 selected for review. The review suggested that functional electrical stimulation (FES) was effective in reduction of subluxation in the acute stage, and that orthoses may reduce the subluxation temporarily.

Shoulder subluxation post stroke is commonly reported (Fil *et al* 2011); however, case studies regarding Spinal Cord Injury (SCI) are difficult to find. There are no papers available that focus directly on this problem or describe in detail the optimum treatment recommendations for this patient group.

This case study intends to provide an overview of treatment methods that were used to treat a shoulder subluxation following an incomplete spinal cord injury.

The patient

A 61-year-old female fell down some stairs resulting in C1 and C2 fractures with subsequent C1-C2 posterior fixation and fusion. She required cardiopulmonary resuscitation following the fall, which was delivered on scene, prior to arrival of paramedics.

Immediately post-operatively, the patient had very minimal upper and lower limb muscle strength, and was dependent for all activities of daily living and personal care. She presented with mild spasticity into triceps bilaterally (modified Ashworth scale 1) and no lower limb spasticity.

Eight weeks post-operatively she was admitted to the London Spinal Cord Injury

Centre, for multidisciplinary (MDT) rehabilitation. On admission she had independent sitting balance and was able to stand with the assistance of two and a rollator frame.

The ASIA International Standards for Neurological Classification of Spinal Cord Injury (ISNCSCI) (American Spinal Injury Association, 2019) assessment done within 24 hours of admission was C2 AIS D.

Impairments

On admission to the London Spinal Cord Injury Centre, lower limb muscle strength was reduced bilaterally. However anti-gravity muscle strength was present in all lower limb muscle groups. The focus of this study will be the anterior and inferior subluxation of approximately 3cm of the left glenohumeral joint (see *Figure 1*). Glenohumeral subluxation is defined as a multidirectional, partial or total change of relationship between the scapula and the humerus (Paci 2005).

The patient's range of movement on admission and eleven months post injury is as shown in *Table 1* below. Range of movement assessment was carried out using a goniometer, by the same therapist throughout the patient's treatment. Muscle strength has been graded within available range, as shown in *Table 2* below.

Intervention

This patient was an inpatient at the London Spinal Cord Injury Centre for approximately eleven weeks, following an eight-week stay at a previous hospital. Subsequently, following discharge she has been reviewed as an outpatient three times. Treatment consisted of the following:

- Kinesio tape (Manufacturer: Kinesio UK. Technique: Mechanical Correction of Shoulder Instability) was applied with the aim to offload and relocate the left glenohumeral joint. A secondary aim of the tape was to reduce pain, thus encouraging



Figure 1 Left shoulder position on admission.

Shoulder	PROM (admission)	PROM (11/12 post injury)	AROM (admission)	AROM (11/12 post injury)
Flexion	90°	170°	30°	110°
Extension	30°	80°	30°	80°
Abduction	90°	120°	30°	160°
Adduction	Full	Full	Full	Full
Internal Rotation (N)	Full	Full	Full	Full
Internal Rotation (900)	Not tested due to pain	60°	Not tested due to pain	60°
External Rotation (N)	Neutral, but painful	15°	0°	20°
External Rotation (900)	Not tested due to pain	20°	Not tested due to pain	45°

Table 1 Left glenohumeral joint passive and active range of movement on admission, and eleven months post injury.

	Admission (November 2017)	Discharge (January 2018)
Scapula		
Elevation	3	4
Depression	3	4
Retraction	2	-3
Protraction	2	-3
Shoulder		
Abduction	2	2
Flexion	2	2
Extension	2-	2
Adduction	2	2
Internal Rotation	3	3+
External Rotation	2	3-
Elbow		
Flexion	2	3
Flexion in mid pronation	2	3
Extension	2-	4

Table 2 Left shoulder joint and elbow muscle strength on admission and discharge. Modified Oxford Scale (Sherman, 2018).

Muscle	Pulse width	Amplitude	Frequency
Triceps	300µs	60mA	50Hz
Anterior deltoid	250µs	60mA	50Hz
Posterior deltoid	250µs	60mA	50Hz
Scapula stabilisers	250µs	60mA	50Hz

Table 3 Treatment parameters for the upper limb FES bike.

mobility. The patient's husband was taught how to safely apply the tape, and carried this out regularly during admission.

- An OmoTrain orthosis (Manufacturer: Bauerfeind), was trialled with a similar aim to that of the Kinesio tape, with the added benefit of compression to aid proprioception.

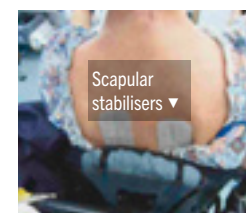
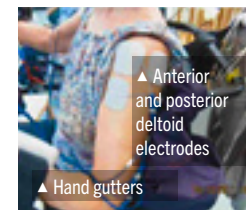
However this patient preferred using Kinesio tape, therefore an OmoTrain was not provided.

- Functional Electrical Stimulation (FES). During her inpatient stay the patient had access to both a portable FES unit (Manufacturer: IntelliSTIM, Model: BE-28E), and an upper limb FES bike (Manufacturer: Cyclone, Model: RT 300). Treatment parameters for the upper limb FES bike were as shown in *Table 3*.

Karaahmeta, 2018 suggests that combining FES-cycling with a standard rehabilitation programme alleviates shoulder pain and may prevent development of shoulder subluxation over time.

The same treatment parameters were used for the portable FES unit, in which stimulation was applied to anterior and posterior deltoid only. The patient's husband applied the portable unit daily, placing electrodes on the anterior and posterior deltoid and also on the scapular stabilisers as shown in *Figures 2* and *3*. The patient carried out her home exercise programme with the device in situ. The upper limb FES bike was used two to three times weekly.

- Range of movement exercises were progressed through supine, side lying, sitting with mechanical dewatering (Manufacturer: Saebø mobile arm support) and standing with mechanical dewatering. Exercises were then progressed from short lever to long lever and resisted exercise, and then progressed from closed to open chain. This intervention allowed for normal isolated shoulder movements.
- Maitland's posterior glenohumeral mobilisations (grade three), in which a posteriorly directed force is directed perpendicular to the humerus, were performed as an outpatient to reduce stiffness of the shoulder capsule and increase joint range of



Figures 2 and 3 Placement of electrodes for use of the upper limb FES bike.

movement. This was not done as an inpatient due to not wanting to reduce compensatory stability mechanisms.

- Facilitation of normal movement to integrate improving range of movement and activity into functional reduction of subluxation during use of upper limb. Including biofeedback, sensory stimulation and pattern correction through handling.

Outcome

Range of movement and muscle strength has increased as demonstrated in the charts above. There is no longer a palpable sulcus. The patient is able to reach the back of her head, behind her back and to her mouth without pain or stiffness. She is currently working on being able to style her hair using her left arm.

At present, her improvement continues and she will be reviewed as an outpatient in three months' time.

Implications for practice

This case study suggests that neurological and functional recovery can continue for at least eleven months following an incomplete spinal cord injury; with ongoing gains in both range of movement and muscle strength.

This case study also supports Peterson, 2004 and Karaahmeta, 2018 that the use of electrical stimulation and taping may play a role in reducing shoulder subluxation. The patient reported a subjective reduction in pain with taping, and felt that this made it easier to carry out her home exercise programme.

Summary

A variety of treatment modalities were used to treat this particular patient, therefore conclusions cannot be drawn as to which treatment may have contributed the most to the current outcome. Anecdotally all have their own value and perhaps it is the combination as a whole that delivered the positive change.

It is noted that the patient received regular therapy both as an inpatient and an outpatient. The patient received 45 minutes of physiotherapy and 45 minutes of occupational therapy, each day, Monday to Friday during her admission, as well as various sessions of group therapy focusing on the upper limb. It is recognised that this is not deliverable in all settings, but with minimal financial expenditure (£50.00 FES machine and pads) and a home exercise programme where therapy equipment can be simulated through domestic furniture, this regime can be recreated within the home environment.

The patient, and her husband, were both compliant with all aspects of treatment which also contributed to the positive outcome.

There is the potential for the treatments discussed above to be applied to other patients with a similar clinical presentation.

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Neurorehabilitation and neural repair conference 2019

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KEY ABSTRACTS

Neurofeedback for central neuropathic pain treatment: mental strategies used for successful neuromodulation

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Introduction: Central neuropathic pain (CNP) is a debilitating problem prevalent in 65% of the spinal cord injury (SCI) population. EEG-based neurofeedback (ENF) is a process where individuals self-modulate brain activity (neuromodulation) using mental strategies (MS). Preliminary research suggests ENF has potential to reduce CNP after SCI.

Main objective: This exploratory study examined people's MS used for ENF neuromodulation, with the aim of understanding the learning process.

Methods: Twelve patients with CNP after SCI were asked to use ENF on a maximum of eight visits, each consisting of six five-minute ENF sessions; no neuromodulation guidance was given. Resting EEG with eyes open was recorded (baseline) before ENF sessions. Participants were asked at the end of each visit about their MS and perceived neuromodulation performance. This was compared to actual performance using frequency spectrum analysis of their EEG activity and comparing baseline to ENF activity. Interviews were analysed using thematic analysis.

Results and discussion: Interviews revealed that mental state (e.g., attentiveness), not MS (e.g., imagination), was associated with neuromodulation success. Unsuccessful patients reported they could not differentiate between successful and unsuccessful strategies; this may be due to an inefficient method of displaying EEG activity.

Conclusion: MS are a mediator, where MS are used to invoke specific cognitive processes (mental state) needed for ENF neuromodulation. The display of EEG activity may need modifications to facilitate learning ENF neuromodulation. Detailed results linking neuromodulation success rates and mental state will be presented.

Acknowledgments: The authors would like to thank DSTL, Spinal Research, SMSR, and NSIC of the Buckinghamshire Healthcare NHS Trust for their support in this study.

Effectiveness of an innovative upper limb programme for stroke survivors: a mixed-methods investigation of quality-of-life outcomes

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Introduction: A major contributor to stroke-related disability is upper limb dysfunction, with significant impact on quality of life. The Queen Square Upper Limb (QSUL) programme aims to provide high intensity, evidence based upper limb rehabilitation focusing on long-term recovery.

Main objective: Evaluate changes in quality of life and explore psychosocial influences on social participation and recovery of stroke survivors following upper limb rehabilitation.

Methods: Mixed-methods with quantitative (pre-to post design with follow-up) and qualitative phases. Subjects included 65 stroke survivors who participated in the QSUL programme from July 2015 to March 2016 with measures including the Stroke Impact Scale (3.0); routinely collected at four time points over six months. Ten stroke survivors were purposively sampled for semi-structured interviews, based on change in Stroke Impact Scale participation domain.

Results and discussion: Significant improvements occurred between time points in seven of eight Stroke Impact Scale domains, overall self-rated recovery ($p < 0.001$) and arm activity ($p < 0.001$). Emotion domain significantly improved from admission to discharge ($p < 0.001$) and declined from discharge to six-month follow-up ($p < 0.001$). Hospital Anxiety and Depression Scale at baseline significantly predicted participation at six months ($p = 0.045$). Interview findings showed four key psychosocial themes with contrasting positive and negative perspectives between high- and low-change groups; themes 'hidden negative effects' and 'loneliness' were evident in the low change group and 'getting on with my life' in the high-change group.

Conclusion: The Queen Square upper limb rehabilitation programme had measurable therapeutic benefits on physical and non-physical quality-of-life outcomes. However, lack of sustained improvement in self-reported emotion contrasts with the clear benefits in other domains indicating a need for ongoing psychosocial support for some stroke survivors, supported by qualitative findings.

Shaping therapy: what influences the content and time for therapy of the upper limb after stroke? A survey of UK therapists

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Introduction: Restoration of upper limb function after stroke is often notoriously difficult and the factors that influence a therapist's practice are unclear.

Main objective: To describe the influences reported by occupational and physiotherapists (OTs and PTs) upon treatment of the upper limb after stroke.

Methods: An online survey - SUPPLES UK - was developed and distributed to UK OTs and PTs currently working clinically with people after stroke via ACPIN, other professional networks and social media. Respondents

indicated how frequently they used ten specific evidence-based treatments and, if they did not use a treatment, explained why. Participants also indicated the factors which influenced the time available to treat the upper limb.

Results and discussion: Complete data were obtained from 85 PTs and 69 OTs ($n = 154$) who were 16.9 mean years qualified (SD 8.8; range 1-36; $n = 154$). The least used treatments were: robotics (rarely or never used by 93%, $n = 143$), virtual reality/video gaming (69%, $n = 106$) and constraint induced movement therapy (66%, $n = 102$). Reasons for rarely or never using a treatment were often related to equipment availability or lack of training. The reported influences on treatment time for the upper limb varied; those cited most frequently were patient availability and condition, competing treatment priorities and evidence informing the dose of treatment.

Conclusion: This survey identifies barriers that UK therapists encounter when trying to implement treatments for the upper limb after stroke and provides greater understanding of the factors that influence practice.

Acknowledgments: We wish to thank all respondents and our funders - the Lancashire Institute for Global Health and Wellbeing (LIFE).

Perceptions of exercise - what moves people with multiple sclerosis to exercise?

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Introduction: Multiple Sclerosis (MS) is a chronic degenerative neurological condition; symptoms include fatigue, balance problems and muscle weakness. Regular exercise is known to benefit the symptoms of MS, but many people with MS are not active enough to achieve these benefits.

Main objective: To determine the perceptions of people with MS about exercise, and their needs relating to participation in exercise programmes.

Methods: 17 people with MS took part in focus groups and individual interviews discussing barriers and facilitators to exercise and their support needs for participation in exercise programmes.

Results and discussion: Three main themes emerged. ‘A very accepting atmosphere’, which highlighted the value of community, both of peers with MS and suitably qualified health professionals to encourage exercise participation. The second theme ‘Future-proof, sustain and build’ recognised the importance of exercise as a way of maintaining abilities and slowing functional decline. ‘Getting going and keeping going’, the third theme highlighted motivational tools for regular exercise. The concept of ‘Acceptance’ of the diagnosis and its associated uncertainties was related to all three themes.

Conclusion: Exercise was highly valued among this group of people with MS as a way to remain functional, interact socially with peers and improve both physical and mental health; nevertheless, appropriate behavioural support is deemed necessary to encourage the uptake and maintenance of exercise to achieve these health benefits.

Acknowledgements: The authors thank the people with MS who gave up their time to participate in this study.

Goal setting for botulinum toxin injections: impact of the upper limb international spasticity (ULIS) programme

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Introduction: The ULIS programme is a series of international cohort studies evaluating treatment of upper limb spasticity with botulinum toxin-A (BoNT-A) in routine practice. Each phase of the programme is supported by investigator training.

Main objective: We explore changes in goal setting and achievement (primary outcome) between the ULIS-II and ULIS-III studies.

Methods: ULIS-II (NCT01020500) followed 456 post-stroke patients over a single BoNT-A cycle. ULIS-III (NCT02454803) examined outcomes from repeated BoNT-A cycles over two years in 1004 patients (various aetiologies). We present ULIS-II data for all patients and preliminary ULIS-III data for the first cycle in 807 patients.

Results and discussion: Study comparisons showed progress in the types of goals set. Whereas the frequency of primary goals increased for pain (from 13.4% in ULIS-II to 25.3% in ULIS-III), reduction of involuntary movement (from 9.0% to 13.3%) and passive function (from 28.9 to 30.7%), rates of goal setting decreased for active function (from 22.8% to 15.0%) and range of movement (from 23.0% to 13.9%). Patterns of injection evolved in line with goal setting. For example, the rate of shoulder injections increased from 32.0% to 39.4% - mainly reflecting the increased recognition of pain as a primary goal. Overall rates of goal achievement fell from 79.6% in ULIS-II to 69.4% in ULIS-III, reflecting a tighter definition of goals.

Conclusion: Developed over a decade, the ULIS programme provides a rich dataset to describe the evolution of routine spasticity management as clinicians start to appreciate which goals are more likely to be achieved for which patients.

Acknowledgments: Funded by Ipsen.

Boost – a self-management programme for people with multiple sclerosis

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Introduction: Self-management for people with multiple sclerosis is used to increase patient knowledge, skills, and self-efficacy to maintain their best health and quality of life. The Boost programme was developed in response to a gap in the local services for people starting to experience the impact of impairments.

Main objective: To evaluate the success of the six-week multi-disciplinary programme of education sessions, and included, exercise and relaxation sessions, for people living independently.

Methods: Attendees were referred from neuro-rehab outpatient services and MS specialist nurses. Face-to-face screening was carried out and ten people attended the programme. Outcome measures carried out at the start and completion of the course included: Hospital Anxiety and Depression Scale (HADS), Warwick Edinburgh Mental Well Being Scale (WEMWBS), Well-being Glass, and a Likert-style measure constructed for the programme.

Results and discussion: Analysis of the results showed improvements in ratings of the WEMWBS and Well-being Glass for most

participants, some showing significant change, and none showing significant decline. Group data analysis of the HADS showed significant improvements in ratings of anxiety and non-significant improvements in depression. In the Likert-style measure, all but one participant showed an increase in scores rating confidence in managing and coping with symptoms. The results are in line with other knowledge about the impact of patient education and peer support for people with long-term conditions.

Conclusion: Findings are limited to a small group of patients who were carefully selected for attendance.

Acknowledgments: Supported by the Oxford Centre for Enablement.

The attitudes of people with progressive MS to the use of mobile applications for symptom monitoring and sharing information with healthcare professionals

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Introduction: Symptom management for people with progressive multiple sclerosis (PwPMS) is essential to quality of life; barriers exist reducing the ability of PwPMS to do this effectively. Mobile apps are increasingly advocated in healthcare to support people to improve health outcomes.

Main objective: To understand the attitudes of PwPMS to using apps for monitoring their symptoms and sharing that information with their healthcare professionals.

Methods: A pragmatic qualitative study. We purposively recruited PwPMS from three MS charities in the UK (n=12). We conducted a focus group with six participants and semi-structured interviews with six different participants. Interviews were face to face or via telephone. Transcripts were transcribed verbatim and analysed using inductive thematic analysis.

Results and discussion: Inclusion of only PwPMS resulted in a population that were older and presented with more complex disability than had been studied before. Similar studies in MS have focused on relapsing remitting MS and excluded these with more complex disability. Participants were motivated to the idea of using apps for symptom management and sharing this information, despite low self-rated confidence with new technologies. Participant technology skill level

resulted in different motivators and barriers to use. Unexpected themes were found such as PwPMS had a poor understanding of symptom management and the potential benefits and there was dissatisfaction with how MS review appointments were conducted.

Conclusion: Apps could be a way to facilitate, engage and motivate PwPMS to monitor and share symptom information more efficiently. Further investigation into PwPMS perceptions of symptom management is required.

Acknowledgments: This research was conducted as part of an MSc in clinical research Methods funded by the National Institute of Health Research (NIHR).

TOPIC 1: ADAPTIVE DEVICES

Walk to the beat: describing the effects of haptic cueing on lower limb kinematics in chronic stroke survivors

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Introduction: Temporal gait asymmetry is a residual impairment experienced by chronic stroke survivors. It is associated with paretic limb knee joint pain and falls. Wearable technologies such as haptic cueing, using vibro-tactiles, could offer a way of continuing effective rehabilitation outside the clinical setting with minimal therapeutic guidance.

Main objective: To evaluate the lower limb kinematic adaptations made by chronic stroke survivors to haptic cueing during walking.

Methods: Nine chronic stroke survivors completed tests of mobility, balance testing and rhythm detection. 3D motion analysis lower limb temporal parameters and kinematics were measured during four ten-metre walks under three experimental conditions:

- Haptic off (familiarisation period)
- Haptic on (the cueing frequency and duration were determined using the IMU data from the haptic off condition)
- Post off (haptic device switched off).

The data was processed in Visual 3D. Mixed method ANOVAs examined differences between hemi paretic and non-paretic limbs joint rotations and velocities for the three conditions.

Results and discussion: Mixed method ANOVA for joint rotations and velocity at the hip, knee and ankle revealed no significant condition effect for all the kinematic variables. However, significant between-limb differences, in the joint kinematic variables during stance gait at the hip and the knee in the sagittal and transverse plane ($P < 0.05$) were found between the three conditions.

Conclusion: These findings demonstrate promise in using haptic cueing to improve gait symmetry in stroke. Further research is now needed to verify these results in a larger sample.

Acknowledgements: This work was funded by the Greater Manchester Academic Health Science Network.

TOPIC 2: COMPREHENSIVE REHABILITATION PROGRAMMES

Can the application of kinesiotape improve functional performance in those with an upper limb neurological impairment?

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Introduction: In a tertiary neurosciences setting upper limb (UL) rehabilitation is challenging. Therapeutic taping is routinely used as part of individualised UL rehabilitation.

Main objective: To investigate the effect of kinesiotape on UL functional performance in patients with acute UL neurological impairment.

Methods: Observational cohort study of acute neurosurgical patients undergoing UL rehabilitation. Therapeutic taping intervention consisted of application of kinesiotape on partial stretch to the dorsal aspect of the affected UL. To assess the efficacy of the therapeutic taping, time taken to complete the Box and Block test (BBT) without and with therapeutic taping was measured. Data was analysed using non-parametric descriptive statistics and Wilcoxon signed-rank test using SPSS.

Results and discussion: Ten patients were studied (male = 5, median (range) age = 58(31-74) years, diagnosis included: spinal cord infarct and acquired traumatic/non-traumatic brain injury.) There was a significant reduction in individual patient time taken (seconds (s)) to complete the BBT test with kinesiotape (32.3 (41.8-16.3) compared to without kinesiotape (48.8 (78.9- 23.7)): median difference = 10.2 (6.9 -38.1), $p = 0.05$. Statistically significant

improvements were observed in performance using therapeutic taping. Whether these improvements can be maintained or increased by using therapeutic taping as an adjunct to rehabilitation needs to be explored. Furthermore, therapeutic taping may improve performance of activities of daily living considering the excellent correlations between the BBT and the Action Research Arm Test ($r = 0.95$) and the Motor Function sub-score ($r = 0.92$) of the Fugl-Meyer Assessment (Platz 2005).

Conclusion: UL therapeutic taping improves individual patients timed ability to complete BBT.

TOPIC 3: GAIT ANALYSIS

Case study evaluating the use of assistive technology and virtual reality (VR) treadmill training for gait re-education in a chronic stage stroke patient

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Introduction: Gait re-education for improved functional mobility is often a patient's highest priority post stroke. Intensive rehabilitation past one year of stroke is not routinely provided by statutory services due to a belief in a plateau of functional improvements.

Main objective: To evaluate whether significant gait changes and functional improvements can be made in chronic stroke using Motek C-Mill Virtual Reality (VR) treadmill training with Augmented Feedback (AF) and other assistive technology.

Methods: Retrospective single case study of a right hemiplegic patient, 37 years old, who suffered brain haemorrhage three years ago. On initial presentation mobilising short



distances indoors with elbow crutch, AFO, knee hyperextension, leg circumduction, severe right-sided sensory impairment. Treatment included: Bioness L300 FES system, initial gait re-education with a TAP splint progressed to custom lycra shorts, intensive Motek C-Mill VR treadmill training using gait adaptability programmes with AF for sensory impairment. Evaluation of treatment records with Motek C-Mill force-plate recordings of step length, stance time, speed, distance, Silicon Coach software gait video analysis.

Results and discussion: Evaluation of treadmill force-plate data shows increased speed, step length, stance time, distance and steps taken. Silicon Coach analysis demonstrates overall improvements in posture and gait pattern using the FES system. The patient's functional goal of mobilising 5km unaided was also achieved. Possibly the AF technology allowed this patient with sensory deficits to improve further.

Conclusion: Results from this single case review highlight that intensive practise with VR / AF treadmill training using assistive technology enhances motor learning, leading to significant functional gait improvements.

TOPIC 4: GUIDELINES/ IMPLEMENTATION/ REIMBURSEMENT

Device design in neurological rehabilitation: managing multiple perspectives

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Introduction: Healthcare teams working with people after stroke are looking to technology to facilitate self-directed practice, increase adherence and motivation and improve the efficiency of healthcare delivery. People with stroke present with a number of impairments which may mean that 'off-the-shelf' technology is not accessible to them. There is a growing body of work aimed at co-producing and co-designing new devices and technologies that are accessible to and appropriate for people following stroke.

Main objective: The aim of this qualitative study was to explore the experiences and perspectives of all stakeholders involved in the co-design of a novel ankle rehabilitation device.

Methods: Semi-structured interviews were conducted with all stakeholders involved in the co-design and development of an ankle rehabilitation device:

- academics (n=3)
- stroke survivors (n=3)
- industry partners (n=2)
- clinicians(n=2).

Interviews were transcribed and analysed using inductive thematic analysis.

Results and discussion: Four key themes were common to all stakeholders: motivation; roles and responsibilities; process of development; and project management. One additional theme (perspective shift) was discussed only by industry partners and service users. Our study identified both similar and differing stakeholder perspectives within these themes, and thoughts and opinions expressed gave insight into the mechanisms and process of co-design, from the perspective of all stakeholders.

Conclusion: Successful co-design requires clear articulation of roles and responsibilities and proactive facilitation to ensure participation and inclusion of all stakeholders in the process. This study offers insights into how co-design could be enacted in future studies.

Acknowledgements: The NIHR Brain injury Medtech and In vitro Co-operative

Evaluating the awareness, implementation and usefulness of national splinting guidelines: a UK-based cross-sectional online survey of neurological physiotherapists

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Introduction: The Splinting Guidelines were developed to support decision-making and reduce variation in splinting practices for adults at risk of contracture due to neurological dysfunction.

Main objective: This study aimed to evaluate UK neurological physiotherapists' awareness of the guidelines and their utility as a practice resource.

Methods: A web-based survey was developed according to the CHERRIES statement, using a literature review and expert consultation, and was piloted. As it was not possible to identify members of the Association of Chartered Physiotherapists in Neurology who undertake splinting, all members on their research database were invited to participate.

Results and discussion: 100 surveys were returned. 85% of physiotherapists reported

being aware of the guidelines and 67% reported an influence on their practice; often supporting clinical decision-making and evidence-based practice. Nearly half integrated them into departmental standards and teaching programmes. Environmental barriers to implementation were associated with limitations in training and resources. Personal barriers were often related to difficulties with application of the guideline recommendations given the provision of only suggestions for practice. Whilst respondents commented on the paucity of evidence upon which the guidance document was developed, most respondents still considered them useful.

Conclusion: Survey findings indicate some uptake of the guidelines as a resource to support best-practice delivery amongst physiotherapists. However the lack of robust evidence available to formulate the guidelines' recommendations was noted as a key limitation. Further high-quality research exploring the effectiveness of splinting is required to build the strength of the evidence-base and inform clinical practice recommendations.

Acknowledgements: ACPIN London Branch for their financial support and all participants.

TOPIC 5: NEUROMUSCULAR DISORDERS/NEUROPATHY

The reliability and feasibility of a handheld dynamometer to measure muscle strength in patients with HTLV-1 infection

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Introduction: Detecting early, evolving change and responses to treatment are important clinically in HTLV-1 infection. Loss of muscle strength is an early sign of onset or worsening HTLV-1-Associated Myelopathy (HAM). The reliability, feasibility and minimal detectable change (MDC) of a handheld dynamometer (HHD) in people with HTLV-1 is unknown.

Main objective: To test a HHD for reliability and acceptability in patients with HTLV infection.

Methods: 30 patients with HAM (pwHAM) and 22 asymptomatic carriers (ACs) were recruited during routine clinic visits. Testing was conducted twice, four weeks apart, of the hip flexors/extensors; knee flexors/extensors,

ankle plantar/dorsiflexors. Participants were randomised to being tested before or after their walking assessments. Standardised testing procedures included three tests per muscle group with ten seconds rest in-between each test. Reliability is reported using the intra-class correlation coefficients (ICC) and its 95% confidence interval and the MDC is calculated as $SEM \times 1.96 \times \sqrt{2}$ where $SEM = SD \times \sqrt{1-ICC}$

Results and discussion: Of the 30 participants with HAM (Male=26, Female=4; mean age 59.5 years) and 22 ACs (Male=18, Female=4; mean age 51.5 years) the median testing times were 18 minutes for HAM and 15 minutes for ACs. Reliability, measured using the ICC, was excellent ($ICC > 0.80$) in pwHAM & ACs, similar to people with stroke and spinal cord injury. However the minimal detectable change was high (24 – 62% in pwHAM) whereas in ACs ranged from 13-23%.

Conclusion: Despite the excellent ICCs in both groups, the amount of change needed in pwHAM to indicate true change is too high to be clinically useful.

Acknowledgements: The authors would like to thank all participants at the National Centre for Human Retrovirology and Imperial Health Charity who funded this project.

TOPIC 6: ORTHOTICS/NEUROPROSTHETICS/FES

The effect of lycra compression on upper limb muscle activity during a reaching task

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Introduction: Impairment of the upper limb is common in neurological injury. Lycra garments have been used in neurological rehabilitation as an adjunct; however, the evidence base remains limited. Lycra has been reported to improve function in children with cerebral palsy and adult stroke survivors. The physiological effect of garments is not clearly understood. Increases in muscle activity around the shoulder have been found in static positions but have not been replicated during functional tasks.

Main objective: To investigate the affect of a Lycra garment on upper limb muscle activity during a reaching task.

Methods: A same subject crossover design was used. 21 healthy participants were randomised to a Lycra or 'no lycra' condition. The garment

comprised an arm sleeve and hand/finger gauntlet. Surface electromyography (EMG) was applied to the anterior/middle deltoid, wrist extensor and long finger flexor muscle groups. Subjects undertook three repetitions of a standardised reaching task. Following an interval subjects repeated the task in the alternate condition.

Results and discussion: When wearing Lycra garments there was a significant 7.5% reduction in middle deltoid activity ($p < 0.001$) and a 32% increase in wrist extensor activity ($p < 0.001$). Changes in activity may only be seen in muscles which are more active during tasks. Decrease in deltoid activity may have been a result of increased activity more proximally around the shoulder girdle which was not investigated. Future study of girdle muscles and alternate functional tasks is warranted.

Conclusion: Lycra garments are increasingly used as an adjunct in neurological rehabilitation. This study adds to the evidence base in this developing area.

A cohort study of functional electrical stimulation in people with multiple sclerosis demonstrating improvements in quality of life and cost-effectiveness

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Introduction: Functional Electrical Stimulation is used to improve walking speed in people with multiple sclerosis and foot drop; this study explores its impact on health-related quality of life (HrQOL) and cost-effectiveness.

Main objective: Does Functional Electrical Stimulation improve HrQOL and walking speed in people with Multiple Sclerosis and is it cost-effective?

Methods: Data on health-related quality of life (EQ-5D-5L and the Psychosocial Impact of Assistive Device Scale; PIADS) and walking speed were collected on 82 patients with multiple sclerosis attending for set up with Functional Electrical Stimulation and at six months. EQ-5D-3L utilities were derived and cost-effectiveness analysis completed utilising a five-year time horizon and methodology and inflated costs published by National Institute for Health and Care Excellence (NICE, UK).

Results and discussion: Significant differences were seen in walking speed with FES use at baseline and maintained over six months ($p < 0.001$). HrQOL significantly improved with

a meaningful mean score in all aspects of the PIADS and a statistically significant change in EQ-5D ($p < 0.001$) over six months. No correlations between changes in walking speed and HrQOL. In the cost-utility analysis, compared to standard care, FES was more expensive and more effective with an incremental cost-effectiveness ratio of £6,137.

Conclusion: FES is a cost-effective treatment to improve walking speed and health-related quality of life in people with multiple sclerosis. Longer term studies on the continued cost-effectiveness and quality of life changes in people with multiple sclerosis and other neurological conditions are recommended.

Acknowledgements: Members of the Functional Electrical Stimulation Service, The National Hospital for Neurology and Neurosurgery, London UK.

TOPIC 7: PARKINSON'S DISEASE

The effectiveness of peroneal nerve functional electrical stimulation (FES) for the reduction of bradykinesia in Parkinson's: a pragmatic feasibility study for a single blinded randomised control trial. The steps project

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Introduction: FES is a means of producing movement in paralysed muscles and is commonly used to correct dropped foot in MS or stroke. Two small studies have indicated that the same technique may reduce bradykinesia, akinesia and hypokinesia in Parkinson's.

Main objective: STEPS aimed to gather information to inform the design of a multicentre trial to demonstrate the clinical effectiveness

of common peroneal stimulation to improve mobility for people with Parkinson's. Feasibility aims included the determination of recruitment and retention rates, acceptability of the protocol and intervention and size of a future study.

Methods: 64 people with Parkinson's were recruited over 18 months at two centres. The control group received normal care. The treatment group received FES and normal care for 18 weeks and were reassessed four weeks after FES was withdrawn. Assessments were ten-metre walking speed and stride length, UPDRS, MiniBESTest, NFOG, FESI, PDQ39, EQ5D5L and a falls-diary. All measures were taken without FES in the on-phase by a blinded assessor.

Results and discussion: Recruitment rate was 1.8 participants per month per centre. 51 participants completed the protocol (retention rate 80%). The protocol was acceptable to participants and walking speed identified as a surrogate marker for overall gait ability. 21 of 32 achieved a substantially clinically meaningful improvement in walking speed of 0.1ms⁻¹ (odds-ratio 5.51(1.77,17.15)).

Conclusion: The feasibility of the study was demonstrated. FES use was associated with reduced bradykinesia, hyperkinesia and akinesia. A fully powered study (n=274-470) is required to confirm these observations.

Acknowledgements: Funded by the RfPB.

TOPIC 8: SELF-MANAGEMENT/EMPOWERMENT

A sustainable model of integrating self-management support across stroke and neurological services: the 'People1st' project

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Introduction: Self-management support has an evolving evidence base for people with neurological conditions and is priority for commissioners of health and social care. 'Bridges' is an established approach to self-management, used in stroke and other complex conditions, that has been commissioned for implementation and evaluation across the East of England, UK.

Main objective: To evaluate the implementation, mechanisms of impact and sustainability of the Bridges self-management approach in neurorehabilitation services in the East of England.

Methods:

- **Participants:** Neurorehabilitation team members, from a range of clinical services, attending training delivered according to the Bridges programme.
- **Design:** Mixed-Methods evaluation consisting of: Participant questionnaires completed pre- and post-training and at three-month follow-up workshops; embedded evaluator observations of Bridges training; semi-structured interviews with sub-groups of multi-professional participants. The evaluation framework, questionnaires and interview topic guides were developed incorporating key concepts from Normalisation Process Theory (NPT).
- **Analysis:** Quantitative questionnaire data will be analysed using descriptive statistics. Qualitative observations and interviews will be transcribed, coded then interrogated using thematic analysis.

Results and discussion: To date (January 2019), a total of 80 hours of Bridges training has been delivered to 204 participants, across six host locations, with pre- and post-training questionnaires completed. Sub-group interviews begin February 2019. Key findings, focused on barriers and facilitators to sustainable implementation of this complex intervention, will be available for reporting May 2019.

Conclusion: This is the first large-scale independent evaluation of the Bridges self-management approach, across multiple clinical settings; it is anticipated that findings will support development of an implementation model for sustainable self-management support in neurological services.

Acknowledgements: The authors would like to thank Health Education East of England for providing financial support to this project.

Stroke survivors' perceptions and experiences of 'next steps group exercise and education programme': a qualitative study

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Introduction: Stroke is the leading cause of disability in the western world. The number of people living in the community with long-term problems with stroke is continuing to grow. Group exercise classes have shown beneficial

effects. 'Next Steps' a group exercise class initiative in the South West of England has shown beneficial effects. However, little is known about stroke survivors' experiences of this 'Next Steps' class.

Main objective: The aim of this study was therefore to explore the stroke survivors' perception and experiences of 'Next Steps' with a focus on education, exercise, social interaction and biopsychosocial outcomes.

Methods: A qualitative study consisting of semi-structured face-to-face interviews was conducted with stroke survivors (n=4). Convenience sampling was used. Interviews were audio-recorded and transcribed verbatim. Data were analysed using principles of thematic analysis.

Results and discussion: Results: Four themes emerged:

- **The importance of tailored exercise:** Patients identified improved strength and function.
- **More relevant education:** Participants identified education could have been more interactive and specific.
- **All in it together:** Participants reported increased motivation due to social interaction which lead to increase confidence.
- **Direction and purpose:** The class provided direction and purpose to participants' ongoing needs.

Conclusion: This study supports the evidence on perceived benefits of group exercise classes. While this study suggests stroke survivors could benefit from education personalisation and exercise delivery adaptations to improve functional outcomes, small convenient samples limit the findings. Further research is required to explore carers and family members' perspectives on group exercise classes for people with stroke.

Acknowledgements: This work was undertaken as part of UG physiotherapy programme at the University of West of England. We would like to thank Bristol After Stroke for help with recruitment and participants for their time.

TOPIC 9: SPINAL CORD INJURY

A single subject case study into functional gait improvements seen 18 months post incomplete spinal cord injury (SCI) using functional electrical stimulation (FES) and augmented feedback (AF)/virtual reality (VR) treadmill training

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Introduction: This case report evaluates the use of FES and AF/VR treadmill training in late SCI rehabilitation.

Main objective: To present the rehabilitation and functional gait improvements of a patient from 9th to 18th month after sustaining a C5/6 SCI.

Methods: Retrospective case study of a patient nine months post SCI receiving treatment twice a week for nine months with a goal to improve walking speed and balance, and reduce spasms which were having a detrimental effect on gait. Measurements were taken throughout using Motek treadmill embedded force plate and video gait analysis.

Results and discussion: Intensive treadmill training using the Motek forcmlink C-Mill treadmill and Bioness L300 PLUS lower limb FES system with a 23-year-old male, who initially presented with AIS D C2 Tetraplegia associated with spastic left hemiplegia including problematic spasms/ clonus inhibiting function. Grade 1 dorsiflexion and reduced passive range of movement (unable to achieve plantargrade). Mobile indoors and out unaided with a Boxia AFO. Berg balance was 47/56 with Boxia AFO in situ. Comparison of baseline and follow-up gait data shows gradual improvement in speed, distance and stride length. Associated with improved active/ passive left LL dorsiflexion range and decreased spasticity. Including FES therapeutic effect, being able to mobilise unaided/without FES or AFO.

Conclusion: The data recorded demonstrated significant functional improvements in gait, reducing the secondary complications of spasticity and loss of ROM, showing carryover of therapeutic gains, to walking without FES, identifying benefits of FES and AF treadmill training, 18 months post SCI.

TOPIC 10: STROKE

'Does this feel like stroke to you?' - a qualitative study of a community neuro and stroke teams' perspectives on stroke with functional overlay and functional neurological disease

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Introduction: Approximately 8.4% of patients admitted to an acute stroke unit are functional strokes and 13% of stroke patients have symptoms that cannot be fully explained by the disease. However, in practice, there appears to be a lack of understanding amongst clinicians with regards to functional symptoms in relationship to stroke patients.

Main objective: The aim of this study was to investigate clinicians' perspectives of functional neurological disorder and functional overlay with stroke.

Methods: Qualitative study design using interpretative phenomenological analysis (IPA) to review data generated from ten semi-structured interviews with experienced clinicians (a stroke consultant, a clinical psychologist, speech and language therapists, occupational therapists, physiotherapists and a nurse) in a Community Stroke Team in England. All interviews were transcribed verbatim and themes were identified from the text, in accordance with the principles of IPA.

Results and discussion: Three main themes were identified from the data collected:

- Making sense of functional overlay; clinicians identified functional overlay as a 'grey, murky area'.
- Functional overlay challenging the medical model; clinicians described the incompatibility of functional overlay with the medical model as potentially problematic, not just for themselves, but also for patients and families.
- Treating functional overlay; clinicians felt frustrated by lack of clear diagnosis, evidence and education.

Conclusion: This research provided an in-depth insight into clinicians' experience of stroke and functional symptoms and identified the need for an overt diagnosis as well as further education and research into this field.

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Sensory attenuation in post-stroke fatigue

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Introduction: Sensory attenuation is a phenomenon whereby the perception (intensity) of afferent input caused by a self-generated movement is reduced. Sensory attenuation provides an account for how two physically identical sensory stimuli can be perceived differently. Post-stroke fatigue may be a result of reduced sensory attenuation. A commonly used method to assess and quantify sensory attenuation behaviourally, is by using the force matching task.

Main objective: Assess whether sensory attenuation is reduced in high fatigue patients using a modified version of the force matching task.



Methods: The study is being carried out in both healthy volunteers and stroke patients with varying severity of fatigue. Subjects performed a simple force matching task in order to quantify sensory attenuation. The force transducer produced pre-determined force levels (1, 2, 3 and 20 Newtons) directly onto the index finger of their non-dominant hand for three seconds (target force). After the three-second time window, subjects were instructed to simply remember the force they just experienced on their finger and do nothing else for a further three seconds. Subjects were then given a cue to match the intensity of the force on the same finger by moving the force transducer using a lever with their dominant hand. Subjects had five seconds to produce the appropriate force and were instructed to hold it (match force) until they saw a stop signal on the monitor.

Results and discussion: Data collection is still ongoing at the time of abstract submission.

Stroke in young adults: quality of life and rehabilitation goals of young adults following stroke

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Introduction: The effect a stroke has on the quality of life of young adults is relatively unexplored, and there are no rehabilitation guidelines that are specifically tailored for them that take into account their aims post-stroke.

Main objective: The aim of this research study was to establish key themes of the difficulties faced by young adults who have had a stroke and their rehabilitation aims.

Methods: Participants who had experienced a stroke (18-40 years: n=6, 41-54 years: n=20, 55-65 years: n=15) were recruited from six health boards in Wales, UK. Data were investigated using interpretative thematic analysis of feedback from participants who were asked to complete a questionnaire asking them to name three things they find difficult and three aims they have had since they had a stroke.

Results and discussion: Two key themes of difficulties emerged: Independence and communication. Sub-themes of difficulties within independence included walking (walking fast, loss of endurance, walking outside and up/down stairs), and inability to complete activities of daily living (washing, dressing and cooking/preparing food). Sub-themes within communication included talking, writing and reduced concentration during a conversation. Regaining independence and participating in social activities were key aims with sub-themes of these including return to work and being able to 'walk normally'.

Conclusion: Understanding the effect of stroke on young adults' quality of life is critical to successful targeted rehabilitation and in enabling a greater proportion of individuals to return to work and participate in social activities.

Pre-movement excitability in post-stroke fatigue

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Introduction: Movement preparation includes predicting the sensory consequences of one's own actions, a key component of sensory attenuation. Movement preparation has been studied using reaction time tasks in which a delay separates an instruction stimulus from a subsequent 'go' cue. Neuronal activity in a number of brain areas is dynamically regulated during the delay period in such tasks. In humans, motor cortex excitability, assessed using transcranial magnetic stimulation (TMS), is transiently suppressed during the delay period and then increases progressively after the 'go' cue before the onset of voluntary movement. The underlying mechanisms and functional role of these excitability changes occurring to movement are still unclear.

Main objective: By measuring motor cortex excitability during a simple warned reaction time task, I set out to answer the following question: does pre-movement motor cortex excitability change as a function of fatigue in stroke patients?

Methods: The study is being carried out in both healthy volunteers and stroke patients with varying severity of fatigue. Subjects performed a simple reaction time task in which an auditory warning stimulus (WS) preceded an auditory imperative stimulus (IS) by a fixed interval of 500ms, and the latter signal cued a response. Participants were instructed to respond quickly and accurately to the IS by making a finger abduction with their index finger. TMS was delivered at time points during the task to assess motor cortex excitability.

Results and discussion: Data collection is still ongoing at the time of abstract submission.

Machine learning-driven personalisation of therapy in a reading rehabilitation app

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Introduction: Alexia is an acquired reading impairment which is often caused by stroke and experienced as part of a generalised communication disorder, aphasia. iReadMore is a digital therapy shown to significantly improve single word reading accuracy and speed for people with central alexia (Woodhead *et al* 2018).

Main objective: In this feasibility study, we aim to demonstrate the methodology that will eventually be applied to optimising and personalising treatment in the iReadMore app.

Methods: Data previously obtained from the phase II trial of iReadMore (Woodhead *et al* 2018) was used to investigate various machine learning models for algorithm optimisation and perform data analyses exploring factors affecting rehabilitation. ML models were compared for their effectiveness in representing patient's rehabilitation progress using reading accuracy and speed as outcomes.

Results and discussion: Completed model analyses using data from 21 patients with alexia will be presented in the poster. Following on from this feasibility study, we intend to use a considerably larger sample obtained from the online roll-out of the iReadMore app to develop the algorithm to allow for personalised treatment.

Conclusion: This feasibility-stage study demonstrated how ML can be applied to complex datasets for data analysis and treatment algorithm-development. These concepts will be the focus of future research.

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The influence of dose, severity of paresis and time on efficacy of lower limb mirror therapy after stroke: an individual participant data meta-analysis

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Introduction: There is evidence to suggest that mirror therapy might improve lower limb function after stroke.

Main objective: To identify whether the efficacy of lower limb mirror therapy may be modified by: dose (the amount of mirror therapy); severity of paresis and/or time after stroke.

Methods: A systematic review conducted according to Cochrane guidelines. Two reviewers independently: identified studies; assessed risk-of-potential bias; and extracted data. Key criteria for inclusion of controlled studies of lower limb mirror therapy for stroke survivors were: the mirror was physically present; the contribution of experimental mirror therapy was discernible; and, motor impairment, functional capacity and/or neurophysiological characteristics were measured. Electronic databases were searched (MEDLINE, PubMed, AMED, EMBASE, CENTRAL, CINHAL complete, PsycINFO, Pedro, Open Grey) using keywords including: stroke, lower limb, and mirror therapy. The reference lists of included studies were searched. Potential risk of bias was assessed using the Cochrane tool. An individual participant data meta-analysis is planned.

Results and discussion: Of 280 studies identified, 118 were removed as duplicates or as irrelevant during review of titles. Abstracts of 162 studies were screened and 35 full papers assessed for eligibility. This process yielded 14 studies for inclusion. Assessment of the risk-of-potential-bias is underway. Initial contacts with authors of included studies are planned for February 2019. Completion of individual participant data meta-analysis is anticipated by mid-May 2019.

Conclusion: It is anticipated that findings from this review will inform future research and clinical protocols for mirror therapy for the lower limb after stroke.

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Redefining conventional neurological physiotherapy, revisiting ten years of data from multisite trials

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Introduction: Treatment schedules designed to capture content of conventional neurological physiotherapy have been used in clinical research trials for the last ten years. This data provides a unique snapshot into NHS provisioned therapy and gives insight into changes related to the delivery of physical therapy interventions delivered to stroke survivors.

Main objective: To investigate change over time in lower limb conventional neurological

physiotherapy provided to participants of research trials with respect to:

- Patient characteristics
- Therapy techniques used
- Dose provided

Methods: Standardised treatment schedules developed through previous consultation with specialist physiotherapists were completed by NHS therapists detailing the non-trial (usual) physiotherapy intervention after each therapy session throughout multisite trials. A retrospective analysis of anonymised trial data from three stroke services across the UK was carried out.

Results and discussion: N=215 stroke survivors from two trials of lower limb therapy recruiting between 2004–2012. Analysis shows dose of physiotherapy (total time) has decreased but the number of therapy sessions remains unchanged, indicating that patients are seen as frequently but for less time. Facilitation of movements has decreased, whereas techniques aimed at functional tasks have increased in line with a move towards task specific practice. Baseline Modified Rivermead Scores show increased severity over time although this may reflect an improvement in recruitment of these patients to trials rather than a change in the overall stroke survivor population.

Conclusion: Trial data from multisite trials between 2004 and 2012 shows a shift in lower limb neurological therapy provision in terms of both content and dose.

The role of multiple demand system in object naming in aphasia

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Introduction: Language processing is generally assumed to be supported by a specialised left lateralised language network, including left inferior frontal cortex (LIFC) as one of the main nodes. Damage to the language network typically leads to anomia – a debilitating deficit in verbal object naming. This network has also been implicated in non-language task and LIFC is proposed to be a part of a bilateral multiple demand system (MDS) – a bilateral network of regions that support domain general processing.

Main objective: To examine whether domain general MDS underlies language processing in individuals with damaged left hemisphere, but spared LIFC.

Methods: To meet the study aim, we used functional fMRI and transcranial direct current

stimulation (tDCS – 2mA anodal vs. sham) to concurrently scan the brain and stimulate LIFC of 18 aphasic stroke participants with left hemisphere lesions, but intact LIFC. Participants gave overt verbal responses during object naming (language) and object size judgement (non-language control) tasks while they viewed high or low visually ambiguous objects paired with high or low auditory ambiguous cues.

Results and discussion: Neurally, a right dominant (SMA, ACC, frontoparietal, striatal) network showed enhanced activity for high compared to low ambiguity auditory conditions, solely in the naming task. Furthermore, anodal tDCS of LIFC improved online naming accuracy.

Conclusion: Involvement of the right hemisphere network during naming supports the view that after acquired left hemisphere damage the multiple demand system supports spontaneous speech performance. Behavioural improvement by anodal tDCS opens promising new avenues for application of online brain stimulation in anomia treatment.

iTALKbetter: the development and testing of a digital neuro-intervention for patients with word-retrieval difficulties caused by stroke

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Introduction: Language impairment (aphasia) is the second most common major impairment after stroke, with a prevalence of 250,000 in the UK. Despite this, provision of speech and language therapy is far below what is needed for optimal rehabilitation (Code & Heron 2003). A common symptom of post-stroke aphasia: impaired word retrieval problems. This is particularly important for patients receiving rehabilitation for associated disabilities as poor speech production can impair participation with treatment programmes.

Main objective: The main aim of our study is to develop and test the clinical efficacy of a novel, digital neuro-intervention. iTALKbetter will provide an effective training tool that post-stroke aphasic patients can use to practise independently.

Methods: Our study has three phases:

- Co-design: development of the app with patients, researchers, and software developers.

- Small-scale randomised clinical trial to test the efficacy of the app in post-stroke aphasic patients.
- Web-release: online roll-out of the app. We will continue to ask scientific questions during this phase.

Results and discussion: Phase 2 will be a small-scale clinical trial with 36 post-stroke aphasic participants. Each will be randomised to one of two versions of the therapy and complete a six-week programme. Data from all five time-points will be analysed using a repeated-measures ANOVA to determine whether there is an interaction between time (therapy block versus baseline) and item (trained vs untrained). Structural MRI data will be analysed using voxel-based morphometry to identify whether our therapy app induces any structural brain changes over time.

Conclusion: All comments and feedback welcome.

Acknowledgements: NIHR, UCL, Neurotherapeutics Group, SoftV.

Across-level generalisation within a novel speech comprehension therapy application, 'Listen-In'

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Introduction: Research investigating the generalisability of aphasia therapy indicates limited generalisation of therapy gains to functional communication following single word impairment-based intervention (Webster, Whitworth & Morris 2015). This is often the case despite the implementation of protocols to promote across-level generalisation (Marshall *et al* 2018). There appear to be some intermediary steps that are required before the learning of single words can generalise across communicative environments.

Main objective: This study aimed to provide a contribution to this topic by investigating generalisation across linguistic presentations (single words, phrases and sentences) within a novel, word-to-picture matching, digital speech comprehension therapy application 'Listen-In'.

Methods: 35 participants with aphasia completed the twelve-week Listen-In intervention programme in which single word comprehension was targeted by presenting items in a variety of spoken word contexts

(single words, carrier phrases and sentences). Hierarchical multilevel logistic regression was then used to evaluate whether improvements on a novel outcome assessment were due to the exposure of the exact linguistic presentation tested post-therapy, or whether exposure to the word in other linguistic presentations also mediated improvements.

Results and discussion: Statistical analysis revealed that all presentation types contributed to improvements following intervention, suggesting generalisation of single word learning across linguistic presentations. Although a secondary finding indicated that exposure to the exact presentation assessed post-therapy was predominantly driving improvements, these presentations were found to be pre-advantaged by the therapy algorithm leading to a greater overall exposure.

Conclusion: This study provides a novel methodology for examining generalisation following intervention and future directions on improving the generalisability evidenced will be discussed.

Acknowledgements: The authors would like to thank the National Institute for Health Research for providing financial support for this project.

Experiences of diagnostic ultrasound-guided shoulder rehabilitation programme for people with stroke: a qualitative study

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Introduction: Stroke is a leading cause of disability in the Western world. Loss of motor control leads to a range of musculoskeletal complications in the shoulder region in people with stroke. These include shoulder pain, shoulder subluxation, muscle weakness and tightness. Our previous work showed that diagnostic ultrasound guided shoulder rehabilitation improved outcomes in stroke survivors.

Main objective: The aim of this study was to explore physiotherapists, and patients, experiences of the shoulder rehabilitation programme that was informed following ultrasound scanning.

Methods: A qualitative study consisting of semi-structured face-to-face interviews were conducted with stroke survivors (n=3) and physiotherapists (n=3) in South Wales. Data were analysed using principles of thematic analysis.

Results and discussion: Four themes emerged:

- **Ultrasound informed treatment:** both physiotherapists and patients reported that ultrasound imaging enhanced their understanding of deficits in the shoulder and facilitated problem-specific treatment.
- **Psychological benefits to patients:** patients' understanding of the problems resulted in compliance and high participation satisfaction towards the rehabilitation programme.
- **Physical and functional benefits:** all three patients achieved improved range of movement in shoulder and therapists described improvements in other aspects such as gait and functional independence.
- **Resource intensive:** The cost and training involved with ultrasound may impose practical challenges for its wider use.

Conclusion: This study provides valuable insight into the personal experiences of novel approaches to shoulder rehabilitation in people with stroke. Physiotherapists were able to target the problem and provide specific exercises which improved patients' outcomes. These findings can be used to guide both the development and evaluation of problem-specific shoulder rehabilitation programmes to improve functional outcomes in people with stroke.

Acknowledgements: This work was undertaken as part of UG physiotherapy programme at the University of West of England. We would like to thank Morello Clinic, Newport for help with recruitment and providing space for interviews, patients and physiotherapists for their participation.

Development of a standardised multidisciplinary upper limb assessment proforma to improve functional upper limb outcome measures in the acute stroke unit setting

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Introduction: 75% of stroke survivors have upper limb symptoms (Lawrence 2001). Over 40% of patients never recover significant function for activities of daily living. Current upper limb rehabilitation is poor with stroke patients only engaged in 'activity' for 13% of the day (Bernhardt 2004) and task specific functional upper limb movements only accounting for 51% of upper limb therapy sessions (Lang 2016). Current NICE

Guidelines for Stroke Rehabilitation (2016) advocate high intensity, repetitive task-specific practice for patients with purposeful upper limb function and education for those with limited movement. However, in a busy acute stroke unit setting upper limb rehabilitation is challenging due to service pressures and environmental constraints.

Main objective: The purpose of this study is to review whether a multidisciplinary upper limb pathway, with a standardised assessment proforma and stratified functional levels, alongside an individualised rehabilitation plan can improve upper limb outcomes.

Methods: Upper limb service provision was benchmarked against other London Stroke Units. From this a multidisciplinary proforma and a standardised upper limb pathway were developed. 15 patients on the local acute stroke unit were included in the study.

Results and discussion: 100% of patients received education booklets and a multidisciplinary assessment. 80% of patients were identified with shoulder pain and were subsequently reviewed by the Consultant within an average of two working days. 100% of patients had upper limb goals set within their admission in comparison to 60% in the four months prior to this study.

Conclusion: Substantial improvements in functional outcome, timely pain management, education and patient satisfaction throughout patient pathway.

Clinical feasibility of a wearable sensor device to support upper limb rehabilitation post-stroke: mechanical muscle activity with real-time kinematics (M-MARK)

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Introduction: M-MARK, a wearable sensor system used during performance of upper limb (UL) exercises, has been developed. The novel approach, which combines inertial measurement units with mechanomyography sensors, aims to improve intensity, motivation

and adherence to rehabilitation. Therapist and patient computer interfaces support design and implementation of personalised exercise programmes, and provide avatar feedback and metrics representing quality and quantity of movement and muscle activity.

Main objective: Usability and acceptability of the prototype in an outpatient clinic setting are reported.

Methods: Six chronic stroke patients attended two testing sessions. UL impairment was assessed (Fugl-Meyer) and an M-MARK exercise programme was designed. Comparator recordings on the unaffected UL were taken. In the first session therapists gave support; in the second participants completed their exercise programme and responded to feedback independently. Observational data were recorded during the intervention, and therapists' and participants' views recorded afterwards using semi-structured interviews.

Results and discussion: Participants could don and doff the garment and found it comfortable; low functioning patients needed some assistance. Therapists were able to design exercise programmes from a library of activities. All participants were able to follow the on-screen and audio instructions and carry out the exercises effectively. They found the system motivating and were able to understand the avatar and written/auditory feedback, with evidence of improved movement when activities were repeated. Issues around garment design, set-up and feedback options were identified.

Conclusion: Having demonstrated usability and acceptability with six participants and two therapists in a clinic, we will evaluate extended home-use, measuring changes in exercise intensity and functional outcomes.

Acknowledgements:
NIHR(i4i-II-LB-0814-20006).

Submission to Synapse

CASE REPORTS

Synapse is pleased to accept case reports that provide information on interesting or unusual patients, which may encourage other practitioners to reflect on their own practice and clinical reasoning. It is recognised that case studies are usually written up retrospectively. The maximum length is 3,000 words and the following structure is suggested:

Title: this should be concise and reflect the key content of the case report

Introduction: this sets the scene giving background to the topic, and why you consider this case to be important; for example, what is new or different about it? A brief overview of the literature or the incorporation of a few references is useful so people can situate the case study against what already is known.

The patient: give a concise description of the patient and condition that shows the key physiotherapeutic, biomedical and psychosocial features. Give the patient a name, but not their own name; photographs of the patient will need to be accompanied by explicit permission for them to be used. Only relevant information to the patient's problem should be included.

Intervention/method: describe what you did, how the patient progressed and the outcome. Aims, treatment, outcomes, clinical reasoning and the patient's level of satisfaction should be addressed. Indications of timescales need to be considered.

Implications for practice: discuss the knowledge gained, linking back to the aims/purpose, and to published research findings. Consider insights for treatment of similar patients, and potential for application to other conditions.

Summary: list the main lessons to be drawn from this example. Limitations should be clearly stated, and suggestions made for clinical practice.

References: the Harvard style of referencing should be followed (please see Preparation of editorial material).

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These should not exceed 4,000 words and papers should include the following headings:

- **Abstract** (maximum of 300 words)
- **Introduction**
- **Method** – to include design, participants, materials and procedure
- **Results**
- **Discussion**
- **Conclusion** – including implications for practice
- **References**

ABSTRACTS OF THESIS AND DISSERTATIONS

Abstracts from research (undergraduate and postgraduate) projects, presentations or posters will be welcomed. They should be up to 500 words, and broadly follow the conventional format; introduction, purpose, method, result, discussion, conclusion.

AUDIT REPORT

A report which contains examination of the method, results, analysis, conclusions of audit relating to neurology and physiotherapy, using any method or design. This could include a Service Development Quality Assurance report of changes in service delivery aimed at improving quality. These should be up to 2,000 words.

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Course, book or journal reviews relevant to neurophysiotherapy are always welcome. Word count should be around 500. This section should reflect the wealth of events and lectures held by the ACPIN regions every year.

PREPARATION OF EDITORIAL MATERIAL

Copies should be produced in Microsoft Word. Wherever possible diagrams and tables should be produced in electronic form, eg Microsoft Excel, and the software used clearly identified.

The first page should include:

- The title of the article
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- A complete name and address for correspondence
- Professional and academic qualifications for all authors and their current positions

For original research papers, include a brief note about each author that indicates their contribution, and a summary of any funds supporting their work.

- All articles should be well-organised and written in simple, clear, correct English. The positions of tables and charts or photographs should be appropriately titled and numbered consecutively in the text.
- All photographs or line drawings should be at least 5" x 7".
- All abbreviations must be explained.
- References should be listed alphabetically, in the Harvard style eg:
Pearson MJT *et al* (2009) Validity and inter-rater reliability of the Lindop Parkinson's Disease Mobility Assessment: a preliminary study *Physiotherapy* (95) pp126-133.
- If the article mentions an outcome measure, appropriate information about it should be included, describing measuring properties and where it may be obtained.
- Permissions and ethical certification; either provide written permission from patients, parents or guardians to publish photographs of recognisable individuals, or obscure facial features. For reports of research involving people, written confirmation of informed consent is required.

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