A prospective case series to investigate current practice in the physical management and its impact on the pattern of limb and spinal deformities in people with a Disorder of Consciousness.

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This report illustrates two case studies of patients in a disorder of consciousness who were prospectively followed for 12 months upon admission to a specialist hospital for people with severe brain injuries.

Setting:

The hospital is a 40-bedded inpatient setting providing rehabilitation and long term care for people with predominantly neurological problems. The clinical team is led by a Consultant in Rehabilitation Medicine and treatment and care is provided by a specialist multidisciplinary team.

Introduction:

Disorders of Consciousness (DOC) are a group of disorders where there is no or very limited levels of consciousness.

Minimally Conscious State: A person with a severe brain injury who show signs which are not reflex in nature and do not occur consistently enough to be used to demonstrate awareness or to communicate (Giacino et al, 2002).

Vegetative State: A patient who demonstrates a sleep-awake pattern, responding to stimuli at a reflexive level and without meaningful response to the environment (Jennett and Plum, 1972).

The most common causes of Disorder of Consciousness in adults are head trauma and hypoxic-ischeamic encephalopathy (MST, 1994). Other causes may include degenerative and metabolic nervous system disorders and severe congenital malformation of the nervous system. The estimated incidence rate is 5 and 25 per million population in the United Kingdom for vegetative state continuing for more than 6 months (Beaumont and Kenealy, 2005). Advances in medical sciences and technology have allowed more severely impaired people to survive and is likely to lead to an increase in the prevalence of people in low awareness states (Royal College of Physicians, 2003).

Complications in low awareness states:

More than 88% of patients with severe brain injuries develop spasticity within 14 days of injury (Verplancke et al, 2005) and the spasticity contributed to joints being held in a shortened position in 18% of this sample. Immobility and sustained posturing, especially in the presence of spasticity, may lead to contractures and deformities, which are major secondary complications with this group of patients (Singer et al 2001). Yarkony and Sahgal (1987) estimated that 84% of patients developed contractures and identified hips, elbows, ankles and shoulders as the most common sites for development of contractures. A further serious secondary complication is pressure ulcer formation associated with prolonged static positioning (Bennett et al, 2004). These complications are common and are observed in patients admitted to rehabilitation and long term units however prevalence of complications in this patient group is not reported.

Any understanding of disease process, specifically improvement/ deterioration in the physical status, will help clinicians plan appropriate treatment strategies. In addition understanding the time course of development of the primary impairments, has the potential to significantly reduce the complications and therefore the cost of care. This is crucial as survival rates in DOC patients is increasing and as a result the long term cost burden to both the state and a person will increase

[current estimated cost for managing these patients vary from £100,000 to £200,000 / year depending on level of complications].

Rehabilitation and Physiotherapy Management for people in low awareness states:

Care is normally provided by an interdisciplinary team in which physiotherapists play a pivotal role (Andrews, 2005). The main role of rehabilitation for this client group, in the acute setting, is to prevent the complications from occurring. However many patients still end up with contractures and deformities of limbs and spine. Data from an audit (at the authors work place) showed contractures in Elbow (67.5%), Wrist (55%), Shoulder adductors (35%), shoulder flexors (32.5%), Hip adductors (30%), Hip flexors (42.5%), Knee flexors (50%), Ankle plantar flexors (45%), Ankle invertors (32.5%), Spinal deformity ('C' OR 'S' Scoliosis and/or Kyphosis in 32.5%) in a population with complex neurological disabilities. In the studied population 26 patients out of 40 presented in a DOC.

There is some evidence that the pattern of spinal deformity is influenced by postures the patients are placed in (Porter et al 2007) and modifying these may prevent the development of these spinal deformities (Pope 2007).

Much of the treatment in current use e.g. serial casting treatments (Verplanke et al 2005), posture management (Pope, 2007), are recommended as essential to prevent deformities and pressure ulcers (RCP, 2013). In the long term care setting the aim of rehabilitation (using the same techniques as above) is to prevent the deterioration of impairments. There is very little information on effectiveness per se although anecdotal evidence suggests there is stabilisation of the level of impairments (whether this is due to a plateau in deterioration or effectiveness of therapy is still unknown.) Reasons for this non availability of good quality evidence in patients with Disorder of Consciousness could be due to the rarity of these conditions, consent issues for involving these unconscious patients in research and clinicians being unaware of and unprepared for managing these patients.

Research Questions:

1. What are the patterns of limb and spinal deformities observed in adult patients with a disorder of consciousness
2. What treatments (specifically related to spasticity and posture management) are provided as part of physical management to patients with a disorder of consciousness
3. How do the interventions provided change the patterns of limb and spinal deformity?

METHODS:

Subject selection:

Three consecutive DOC patients admitted to the hospital were selected for the study. Consent was obtained from patient's next of Kin and from the Consultant in Rehabilitation Medicine. Unfortunately, one patient died 5 weeks after admission. The data collected from the other two patients is presented as two case studies.

Outcome measurement:

Range of movement (ROM) of Hip (Flexion/ extension, Abduction/ Adduction), Knee (Flexion/ extension), Ankle (Plantar/ Dorsi flexion, Inversion/ eversion), Shoulder (Abduction/ Adduction/ Flexion/ Extension). Elbow (Flexion/ extension) and Wrist (Flexion/ extension) were measured.

Increase in muscle tone was measured using the Tardieu method (Gracies et al, 2010) for the muscle groups involved. Muscle groups measured were Hip (adductors, flexors), Knee flexors, Ankle (Plantar flexors, invertors), Shoulder adductors, Elbow flexors and wrist flexors.

Spinal deformities were measured and monitored by taking photographs from all angles (back, front, top, side) with small bright stickers/ markers along the spine, as described by Porter et al (2007). The degree of deterioration/ improvement from the photos was quantified by comparing photos of patients from previous months/year by Physiotherapists blinded to the photographic sequence (i.e. blinded to the month/ year photo was taken).

Measurement protocol:

• All measurements were recorded by the same assessor. Assessors were physiotherapists who had completed the three-day posture management course

• Range of movement was recorded by an assessor blinded to previous measurements

• All ROM measurements were measured using the Neutral-0- method

• Standardised positions as described in the Oxford Centre for Enablement PG Certificate course handbook were used when taking measurements

• Measurements were taken at 0, 1, 3, 6 and 9 months' post admission.

Patient introductions:

Patient 1 was 20 years old at admission and was 114 days' post injury. She was an unrestrained driver who was involved in a road traffic accident when she was 19. She suffered an open skull fracture, base of skull fracture, subdural and subarachnoid haemorrhage with cerebral contusion. She underwent decompressive craniotomy at a major trauma centre and was transferred to the local Hospital's high dependency unit. She had unstable type one Diabetes Mellitus and was dependent on a tracheostomy. She had occasional seizures which the medical team thought was related to issues with VP shunt.

Patient 2 is a long standing 77-year-old diabetic who was admitted 160 days' post injury. She suffered a hypoxic brain injury post status epilepticus. She required artificial ventilation initially via an endo-tracheal tube which was subsequently replaced by a tracheostomy. She remained in an unresponsive state and was thought to have suffered a cerebral event. She was eventually weaned from the ventilator but remains dependent on the tracheostomy to maintain her airway and manage secretions.

	Patient 1	Patient 2
Age on admission	20	77
Diagnosis	Vegetative state	Minimally Conscious state
Type of brain injury	Traumatic brain injury resulting in DOC	Hypoxic brain injury post Status Epilepticus resulting in DOC
Tracheostomy	Yes	Yes
Other medical condition (s)	Type 1 Diabetes Mellitus	Long standing Diabetes
		Behavioural issues – Risk of self-decannulation of tracheostomy from non-purposeful active movement in all limbs. Managed with 1-to-1

		supervision for the first 6 months then gradually weaned.

Table 1: Patient characteristics

Goals for patient 1 & 2

- Maintain range of movement Hip, Knee, Ankle, elbows, wrist and shoulders.
- Tracheostomy weaning - Start with Cuff deflation trials.
- Prevent spinal deformities (Scoliosis and Kyphosis) from occurring

Care planning and Photographic guidelines:

Both patients had a 24-hour posture management protocol in place. As part of the protocol, both patients had a wheelchair/ seating care plan, a bed positioning care plan and a splinting care plan. The care plans were risk based and included the procedures to be followed (e.g. how to stretch the limbs when positioning) and what aids to be used (T roll, pillows etc) and how tolerance was being built (Copies of the care plans provided in Appendix 1 & 2). These care plans and photographic guidelines (Appendix 3) were available at the patient's bed side and were a source of reference to all staff. The care plans were reviewed monthly and were rewritten every 12 months or when there was a major change in the patient's condition.

All clinical staff (nurses, therapists, assistants and health care assistants) received 24-hr posture management training as part of the two-week induction and an update training every 12 months. Informal problem solving workshops were also held as needed.

Physical management interventions provided:

Positioning in bed and wheelchair: Upon admission patients went through comprehensive Physical assessment including range of movement measurements, Postural assessment in lying and sitting and assessment of spasticity. Upon completion of the assessment SMART goals were set for the patients and a management plan developed. When patients were admitted without a wheelchair or positioning aids they were provided with loan equipment. Wheelchair, special seating or bed positioning aids prescriptions were sent to funding authorities if a considerable amount of funding was required (> £1000). Minor items e.g T roll (£175) were provided by the hospital.

Splinting: Most splints were made in-house by the therapists and rarely were splints bought off the shelf. Splints were made using fibreglass (3M Scotch and Soft cast) or thermoplastic materials. Splints were mostly applied by therapists and therapy assistants. Usually splints were worn for the duration patients were sat up in the chair. If indicated splints were applied by night staff.

Spasticity management: Patients were assessed by Physiotherapists (Botulinum Toxin injectors) and Consultant in Rehabilitation Medicine. The oral anti-spasticity medication dose was reviewed by the Consultant in regular intervals and Botulinum Toxin injections provided as needed. External referral, if indicated, were made to Neurosurgery team for intrathecal treatments.

Other Physiotherapy interventions: Other treatments provided included Tilt table/ standing frame standing, Active passive cycle exerciser, Aquatic therapy and stretching/ mobilisations on the plinth.

Patient 1 used a tilt in space wheelchair (Figure 1) with a standard pressure relieving cushion. T roll, log roll and pillow support were used to position her in bed in supine and side lying. She was turned every 3-4hrs when in bed. She was able to manage 4-6hrs a day sitting up in the wheelchair. The wheelchair had a head rest, thoracic supports on both sides and an adjustable leg rests. During the study period, due to lack of head control and to prevent head flopping forward, a Philadelphia collar

(with a tracheostomy port) was used in addition to a deep 'U' shaped headrest. She gradually regained head control and the collar was no longer needed at 12 months after admission.

Figure 1 Tilt in space wheelchair

Figure 2: Philadelphia collar with Tracheostomy port

Patient 2 used a tilt in space wheelchair with a standard pressure relieving cushion, head rest, tray and lateral supports. She was positioned in bed with a T roll (Side and supine lying) and pillows for support. The interventions provided to patients 1 & 2 is shown in table 2.

Interventions	Patient 1	Patient 2
Posture management (wheelchair positioning)	Tilt in space wheelchair with pressure relieving cushion, 'U' shaped headrest, tray, lateral supports and leg rests	Tilt in space wheelchair with pressure relieving cushion, headrest, tray, lateral supports and leg rests
Posture management (bed positioning)	T roll, log roll and pillow support. Profiling bed.	T roll and pillow support. Profiling bed.
Splinting	Off the shelf palm protector splints. Fibreglass elbow and foot splints.	Fibreglass splint for right foot
Spasticity management (Oral anti-spasticity medication)	Baclofen 20mg TDS via peg	
Spasticity management (Botulinum Toxin type A injections, Xeomin, Merz Pharma)	Both Gastrocnemius and Soleus (300U) without follow up Physiotherapy as patient was unwell after the injections	Right Gastrocnemius and Soleus injected (200U) with Post injection stretching, tilt table standing and splinting (fibreglass) regime.
Other Physiotherapy	Aquatic therapy, Passive Stretching, ROM exercises on the plinth, Active passive cycle exerciser.	Supported/ Tilt table standing, Active passive cycle exerciser, passive stretching and ROM exercises on the plinth

Table 2: Treatments received by Patients 1 & 2 during the study period

RESULTS:

Upper and lower limb range of movement:

Both patients are still resident in the hospital. Data collected 36-40 months' post admission is presented in addition to the results during the 12 months' study period.

Both patients maintained ROM in most of the upper limb and lower limb joints. Loss of ROM was noticed in Ankle, Elbow and Wrist joints. The biggest deterioration for patient 1 was in elbow extension (graph 1, lost 20 degrees) 3 months' post admission. She regained the lost range after splinting the limb in submaximal stretch for 4-6 hours a day and had maintained the ROM at 36 months' review. A selection of ROM changes in patient 1 is presented in the figure 1 below.

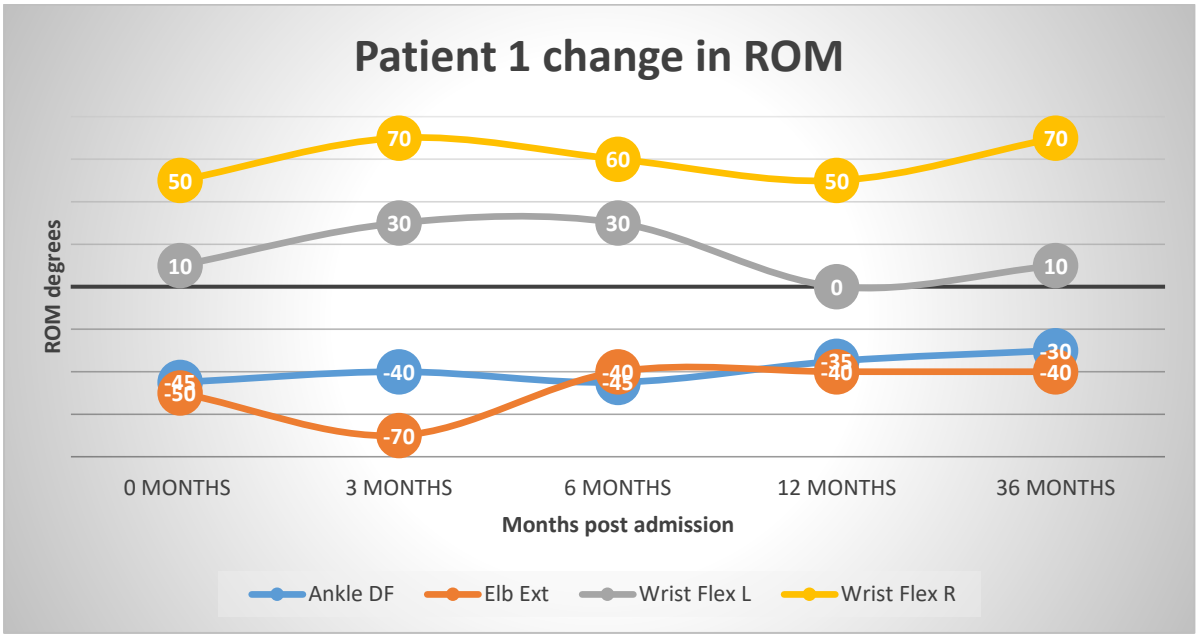

Figure 1: Change of ROM in patient 1

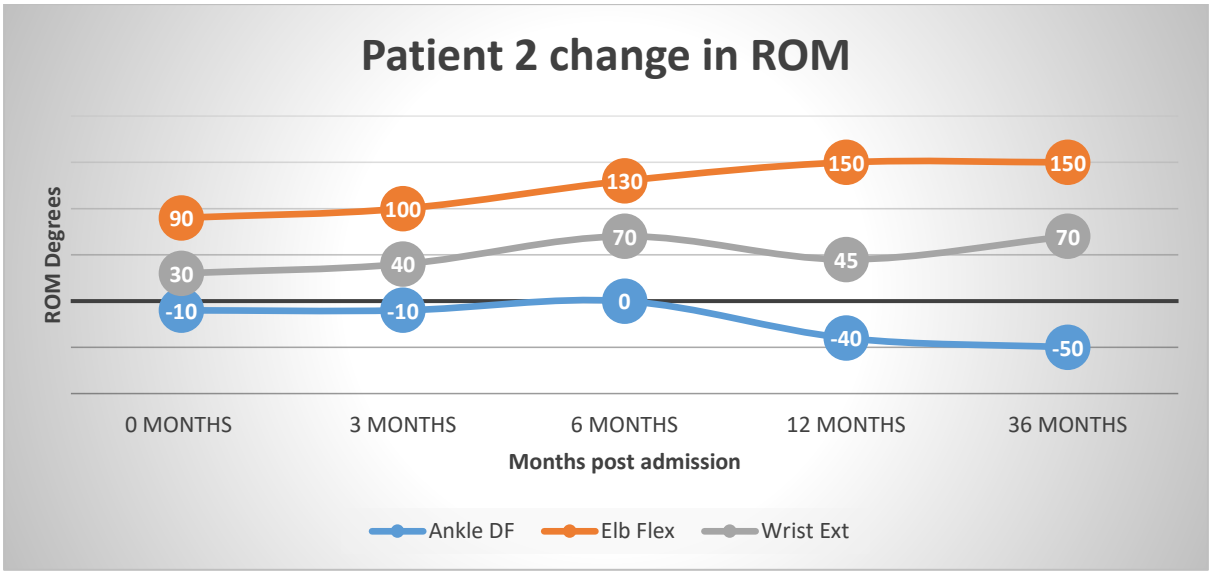

Figure 2: Change of ROM in patient 2

Patient 2 was equally stable and maintained most of the upper and lower limb joint range of movements except a 30° loss in Ankle dorsiflexion ROM. Maintaining other joint ROM was not unexpected in patient 2 as she had non-purposeful active movement in all four limbs. However, the movements created risks associated with the patient pulling out her tracheostomy tube. She gained

60°and 40° in Elbow and Wrist joints respectively (Figure 2). For both patients all the other range of movement remained stable with minor variations within a 10° range.

Spinal deformity:

The postural assessments photographs (bright stickers placed along the spine) were taken from different angles in addition to photographs of patients sitting in the wheelchair and when positioned in bed using the positioning aids. The Photographs from the 0, 3, 6, 12 and 36 months were printed, arranged in a random sequence and presented to three different physiotherapists to quantify if there was any improvement or deterioration in the patient's spinal deformity. There was over 95% consensus among the Physiotherapists (a total of 90 photographs were used) that there was no/ very minimal change in the scoliosis or Kyphosis in both patients.

Complications and adverse events:

Both patients presented with extremely variable blood sugar levels during the study period. Patient 1 had an unstable period with malfunctioning Ventriculoperitoneal shunt. She needed admission to an acute hospital to manage this and developed pressure ulcers in the heels during this admission. The seizures she experienced during the study period were also attributed to the shunt problems. Both patients had episodes of chest and urinary tract infections requiring treatment with antibiotics. Patient 2 had various episodes of agitation during which she would hit at staff or pull the tracheostomy tube out. This settled down 6 months after admission and was managed with 1-to-1 supervision.

Patient 1	Patient 2
Urinary tract infection	Chest infection antibiotics
Twitching/ Seizures	Eye infection - antibiotics
Variable blood sugars (range 3.7-21 mmol/l)	Variable blood sugars (range 1.7-22.2 mmol/l)
Chest infection treated with Antibiotics	Many episodes of Self decannulation and hitting staff
Spiking temperature Shunt problems (Blockage) Pressure areas from acute hospital admission	

Table 3: Complications observed during the study period

Spasticity:

Patient 2 had non-purposeful movement in all four limbs which may have masked any muscle activity during assessments. Patient 1 presented with mild to moderate spasticity in elbow flexors and knee extensors. In patient 1 a large difference was noted in both elbow flexors (R1-R2) and left knee extensors indicating a dynamic component. Patient 1 was managed with static customised splinting and active passive cycle exerciser for the lower limb muscles.

Muscle group	Side	V (velocity)	X	Spasticity angle		R1-R2	Modified Ashworth
				R1	R2		
Elbow Flexors	L	2	2	90	50	40	2
	L	3	2	90	50	40	
Elbow Flexors	R	2	2	100	60	40	3
	R	3	2	110	60	50	
Wrist Extensors	L	2	0	5	-5	10	1
	L	3	0	5	-5	10	
Wrist Extensors	R	2	1	-20	-20	0	1
	R	3	1	-20	-20	0	
Knee Extensors	L	2	2	-50	-135	85	2
	L	3	1	-50	-135	85	
Knee Extensors	R	2	0	-135	-135	0	1
	R	3	0	-135	-135	0	
Ankle PF	L	2	0	45	45	0	1
	L	3	0	45	45	0	
Ankle PF	R	2	0	-50	-50	0	1
	R	3	0	-50	-50	0	

Table 4: Spasticity measurements for patient 1 (3 months) using Tardieu method

DISCUSSION:

The interesting observation from this two case studies is how well their joint ROM and spinal deformity were maintained from the point of admission to up to 40 months. This can be attributed to

1. Treatment provided by specially trained professionals
2. Frequency and intensity of therapy intervention especially in the first 12 months

Treatment provided by specially trained professionals

Normal rehabilitation practise for patients with a Disorder of Consciousness is to develop a disability management programme during their stay at the rehabilitation unit and then for the programme to be carried over by care staff either in the patient's own home or in a specialist nursing home. The recommendation in the RCP PDOC guidelines (2013) is for the patient to be reviewed once a year by a specialist Neurorehabilitation team. Patients in this case study were taken care of by a specialist Multidisciplinary Team (MDT) lead by a Consultant in Rehabilitation medicine resulting in a very high quality input.

A robust 24-hour Posture management programme was in place for both patients. A physiotherapist with PG Certificate in Posture management prescribed the 24-hour programme and the availability of a range of seating equipment (tilt in space wheelchairs, soft chairs, sleep systems), and postural aids (T, E, log rolls, wedges, wheelchair accessories – head rests, foot rests, trays etc.) were helpful.

The Consultant had a special interest in managing people with complex Neurodisability and Botulinum Toxin use for managing spasticity. Two physiotherapists were also qualified injectors who assisted in the assessment of spasticity, provision of Botulinum toxin injections and post injection management. The MDT were also able to refer to patients to appropriate specialists for intrathecal treatments if indicated.

Splinting for the management of spasticity and contracture was provided in house. With most splints made on site using Fibreglass or thermoplastic material, helping to reduce the rate of associated complications i.e. pressure ulcers, circulation problems. In addition to the Physiotherapists and Occupational therapists, other MDT members were also contributing to the physical management plan. This is listed in table 5 below.

- Highly skilled nurses and carers help
  - maintain lower infection rates
  - Implement 24-hour posture management out of hours (evenings, nights and weekends). Nurses and HCA's are trained to a very high level through formal and informal sessions
- All patients are reviewed by a specialist dietician.
- Daily doctor (experienced in complex Neurodisability) visits to monitor unwell patients
- Weekly consultant in Rehabilitation Medicine led ward round providing specialist Neurorehabilitation input.
- Special interest groups (SIGs), (posture management, disorder of consciousness) a multidisciplinary advisory group led by a Physiotherapists, provide training and problem solving sessions for other members of the MDT
- Access to expert clinical supervisors who are attached to Universities or other centres of excellence

Table 5: Specialist multidisciplinary (non-Physio/ OT) input

While it is difficult to replicate this multidisciplinary team and protocols in every single setting (care home and long term units), it may be worth encouraging professionals from specialist units to provide outreach services (staff training and clinical input) within a reasonable geographical area.

Frequency and intensity of therapy interventions:

Both patients received 3-5 sessions per week from Physiotherapists and Occupational therapists in their first 12 months. These interventions were provided in addition to the splinting (carried out separately by Physiotherapists/ assistants) and 24-hr posture management protocol (carried out by nurses and HCAs). Frequency of this specialist input could have helped stabilise the impairments in the early stages (12-18 months' post injury) resulting in a reduced need for physiotherapists input. Currently both patients receive one session a week (either tilt table standing, passive cycling or passive stretches) provided by the therapy assistants. The value of passive stretching as part of the disability management programme may be beneficial, but there has been some suggestion that evidence for the effectiveness of passive stretches in ABI patients as very limited (Katalinic, 2010). A larger study will be needed to confirm or refute these suggestions.

Facilities available in the hospital:

One of the contributors to very good management of these patients was the facilities available at the hospital. All patient rooms are equipped with ceiling track hoist making positioning and transferring patients easier for staff. This has been highlighted in an earlier qualitative study that looked at nurses and carers views of 24-hour posture management (Mohammed Meeran, 2008). Access and readily available loan equipment (wheelchairs and positioning aids) could have also

contributed to an effective 24-hour programme being set up within days after admission to the Hospital.

A major advantage of preventing complex limb contractures and spinal deformities is that it negates the need for expensive equipment for example a customised seating system that could cost many £1000s more than a standard tilt in space wheelchair. When the replacement costs for these seating systems are taken into account the cost savings could mount to a very large sum.

There is evidence to support very early development of contractures in people with acquired brain injury (Verplancke et al 2005) and in people with a disorder of Consciousness (Wheatley-Smith et al, 2013). In their retrospective study Wheatley-Smith et al observed that 45% of all joints measured were contracted at admission. An important question to consider is whether any intervention in the early weeks and months after the injury could have prevented the residual deformity in both patients' ankles, Elbows and wrists?

In patient 2 the non-purposeful active movement in upper and lower limbs could have contributed to maintaining the ROM and muscle length. The increase in the elbow and wrist joint ROM at 6, 12 and 36 months (Figure 2) could be attributed to the patient's agitation settling down, leading to a reduction in the resistance experienced by the therapists when assessing (moving) the joints. The reliability of visual estimation of the joint angles could also be questioned as highlighted by Parker (2013).

Beyond the study period (12-40 months)

Patient 1: Patient's next of Kin was keen for the cranioplasty to be performed. It was discussed by the MDT and agreed as being in the patient's best interests. This was carried out 15 months' post admission. Patients medical condition stabilised few months after the cranioplasty with reduced seizures and temperature spikes. At 30 months' post admission, patient's muscle tone reduced allowing Physiotherapists to manage ROM and spasticity without elbow splints. A big step came between 36 and 40 months when the patient was deemed fit enough to trial Tracheostomy weaning. She was decannulated successfully and was stable at the time of writing this report. The MDT are working through goal setting to help the patient achieve her maximum potential. While there are reports of unexpected or delayed recoveries (Sara et al, 2007, Matsuda et al, 2003) of people in Vegetative states, how patient 1's recovery follows remains to be seen.

CONSLUSION:

The two case studies illustrate the importance of providing specialist physical management interventions to DOC patients to maintain joint range of movement and spinal deformity especially in the first year after the injury. The variability in the physical management practice needs to be addressed urgently. One step to address this could be to develop a clinical practice guideline in physical management for clinical staff to refer and use.

References:

- Andrews (2005) Rehabilitation practise following profound brain damage. Neuropsychological rehabilitation.15 (3/4) 461-472
- Beaumont, J.G. & Kenealy, P.M. (2005). The incidence and prevalence of the vegetative and minimally conscious states. Neuropsychological Rehabilitation, 15, (3/4)184-189.
- Bennett G, Dealey C, Posnett J (2004). The cost of pressure ulcers in the UK. Age and Ageing 33 (3): 230-235
- Ryf C , Weymann A (1999) Range of Motion - AO Neutral-0 Method: Measurement and Documentation, Book & CD-ROM. Thieme medical publishers.
- Giacino J T, Ashwal S, Childs N, Cranford R (2002) The minimally conscious state: Definitions and diagnostic criteria. American Academy of Neurology; 58: 349-353.
- Gracies JM, Burke K, Clegg NJ, Browne R, Rushing C, Fehlings D, Matthews D, Tilton A, Delgado M (2010) Reliability of the Tardieu Scale for assessing spasticity in children with cerebral palsy. Arch Phys Med Rehabil. Mar; 91(3):421-8.
- Katalinic OM, Harvey LA, Herbert RD, Moseley AM, Lannin NA, Schurr K. (2010) Stretch for the treatment and prevention of contractures. Cochrane Database Systematic Review;
- Matsuda W, Matsumura A, Komatsu Y, Yanaka K, Nose T. Awakenings from persistent vegetative state: Report of three cases with Parkinsonism and brain stem lesions on MRI. Journal of Neurology, Neurosurgery & Psychiatry 2003;74:1571–1573.
- Mohammed Meeran RA (20080 Positioning patients in low awareness states in wheelchair and bed: experiences of nurses and health care assistants (HCAs). Posture and Mobility Group. file:///C:/Users/rasheed/Downloads/MEERAN%20FULL%20REPORT.pdf
- MST: Multi Society Task force on PVS (1994). American academy of Neurology, 2221 University Ave. S.E, Minneapolis, MN 55414.
- Parker (2013) Reliability of visual estimation of angles relating to joint range of motion in rehabilitation. Posture and Mobility Conference proceedings.
- Pope, P (2007) Severe and Complex Neurological Disability: Management of the Physical Condition. Butterworth-Heinemann
- Porter D, Michael S, Kirkwood C (2007) Patterns of postural deformity in non-ambulant people with cerebral palsy: what is the relationship between the direction of scoliosis, direction of pelvic obliquity, direction of windswept hip deformity and side of hip dislocation? Clinical Rehabilitation; 21: 1087–1096
- Royal College of Physicians. (2003) The vegetative state: Guidance on diagnosis and management.
- Royal College of Physicians. Prolonged disorders of consciousness: National clinical guidelines. London, RCP, 2013
- Sara M et al (2007) An unexpected recovery from permanent vegetative state. Brain Injury, 21(1): 101–103
- Singer, B., Singer, K.P., & Alison, G. (2001) Serial plaster casting to correct equinovarus deformity of the ankle following acquired brain injury in adults. Disability and Rehabilitation, 23 (18), 829-836.
- Verplancke D, Snape S, C F Salisbury, P W Jones, A B Ward (2005) A randomized controlled trial of botulinum toxin on lower limb spasticity following acute acquired severe brain injury Clinical Rehabilitation. 19 (2) 117-125
- Wheatley-Smith et al (2013) Intensive physiotherapy for vegetative and minimally conscious state patients: a retrospective audit and analysis of therapy intervention. Disability And Rehabilitation Vol. 35, Iss. 12,2013
- Yarkony GM, Sahgal V. (1987) Contractures. A major complication of craniocerebral trauma. Clinical Orthopaedics Related Research.(219): 93-6.

Appendix 1 – Copy of a wheelchair care plan

HOLY CROSS HOSPITAL
CARE PLAN

Name:	**DOB**:
Risk no: **13** - Wheelchair	

Description of risks:

Inappropriate and prolonged positioning in wheelchair may lead to:

1. **Discomfort, distress and increased tone**
2. development of **pressure ulcers**
3. development of **contractures/deformities**:
   - improper positioning of lateral supports may lead to scoliosis
4. **falls** due to:
   - inappropriate tilt or recline of wheelchair
   - Inappropriate application of pelvic strap

Please rate risk if no action taken

Review date	Risk no	High	Medium	Low	Signature
Jan '16	1		√		
Jan '16	2		√		
Jan '16	3		√		
Jan '16	4		√		

Type of chair: Rea-assist with standard foam cushion
Accessories: head rest, pelvic straps (front fastening and rear fastening), lateral supports,
Length of time in chair: 4-6 hours

Management/care plan:
Risk 1:
1.1 Follow the wheelchair positioning guideline when sitting . X in her wheelchair.
1.2 When hoisting . X into his wheelchair, ensure that she is sitting right back in the seat and that her pelvis is in neutral rotation and tilt.
1.3 Tilt . X's chair fully to 20° so that knees are positioned higher than hips.
1.4 Pillows to be used to support her arms. Ensure her feet are supported by the foot rests.
1.5 Position head rest to accommodate a neutral head position (not flexed or extended as this may cause difficulty in swallowing and in breathing).
1.6 Review . X's position in her wheelchair at regular intervals.
Risk 2:
2.1 Document duration . X spends in her wheelchair in the combined observation chart and limit her sitting hours to 6 hours or as instructed by the Nurse-in-charge.
Risk 3:
3.1 Secure the head rest with the screws at the right height.
3.2 Place the lateral supports to position the trunk in midline and secure in place with the screws.

3.3 Refer to 1.6.

Risk 4:

4.1 Securely fasten both pelvic straps when . X is sat in her wheelchair.

4.2 Refer to 1.3.

4.3 Refer to transport guidelines when transporting . X in ambulance.

General notes to the staff:

1. Document any fault in the wheelchair or accessories in the clinics referral form and inform a member of the therapy team.
2. Please contact a member of therapy team if you have any queries regarding positioning . X in her wheelchair.
3. Check for updates in additional comment/ deviation sheet.
4. Please refer to care plan no 18 Safety for guidance on restraints related to use of tray, lateral supports, lap belts and tilt action of chair.

Signature: **Date:**

Print name: **Designation:** Specialist Physiotherapist

Managed risk – please rate with care plan in place

Review date	Risk no	High	Medium	Low	Signature
Jan '16	1			√	
	2			√	
	3			√	
	4			√	
Feb '16	1				
	2				
	3				
	4				
Mar '16	1				
	2				
	3				
	4				

Appendix 2 - Splinting protocol - Sample

IN WHEELCHAIR:

Elbow splints for both elbows

12th November 2012 Monday	30 minutes
13th Nov	45 minutes
14th Nov	1 hour
15th Nov	1.5 hours
16th Nov	2 hours
17th Nov Saturday	2 hours
18th Nov Sunday	2 hours
19th Nov Monday to 25th Sunday	2.5 hours
26th Monday to 2ND December	3 hours

IN BED:

When on his back

THERMOPLASTIC HAND SPLINTS for 4 hours

Refer to care plan no.13 for management plan and to document any deviations.

Please contact a member of the therapy team if:

- Patient shows any redness 30 minutes after removal of the splints
- There is any swelling after or before application of the splints
- There is any break in the skin
- Patient shows signs of discomfort or pain
- You have any queries regarding application of the splint at ext: 288/ 334
- Complete a referral form if there are any issues related to splinting

Thanks
Therapy Team

Rasheed Meeran (Physiotherapy Team Leader) _____12/11/2012

Appendix 2 - Bed Positioning Photographic Guideline - Sample

Date 12-02-2009

Guidelines for Positioning Mr. Bloggs in Side Lying

Insert photograph taken from the top view (ceiling)

- **Place "pillow" under Blogg's head and ensure that his head is in neutral position**
- **PULL THE BOTTOM SHOULDER OUT to prevent any direct pressure going through it**
- **Make sure that the back is fully supported by using 1 or 2 pillows as shown**
- **Use pillows under both arms for support.**
- **Ensure that the head end is tilted up to 45°. Position the hip in line with the hip break of the bed. DO NOT USE THE KNEE BREAK WHEN LYING ON THE SIDE.**
- **Use the T-roll between his knees then put 1 thin pillow between the feet.**