

Management of Acute Spinal Cord Injury

Charles Greenough

9th March 2015



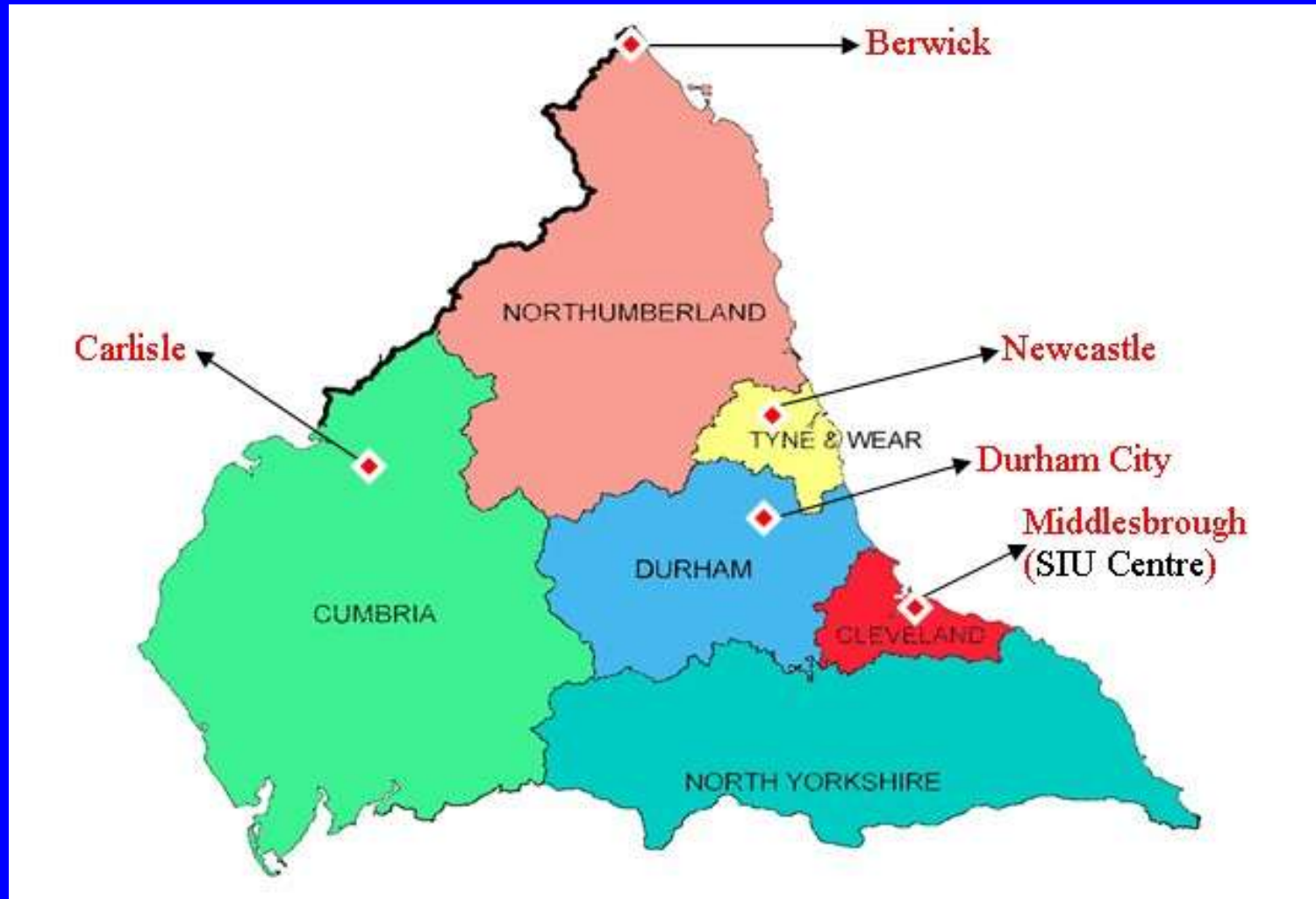
Middlesbrough

The image shows the exterior of a modern, multi-story building with a prominent entrance. The building features a mix of brickwork and large glass panels. A wide, paved walkway leads to the entrance, flanked by landscaped gardens with various shrubs and plants. A blue van and a red car are parked in a designated area to the right of the entrance. A tall street lamp stands near the parking area. The sky is overcast.

THE GOLDEN JUBILEE REGIONAL SPINAL CORD INJURIES CENTRE

The Golden Jubilee Regional Spinal Cord Injuries Centre

Catchment Area



The Problem

569 Admissions to Sheffield Spinal Centre

- 52 cord injuries missed at presentation (9 %)
- Median delay 4 days (10 hours – 6 weeks)
- 26 mismanaged (50 %)

The Problem

52 Missed injuries

Where ?

The Problem

52 Missed injuries

- C 1/2 1
- C3 – C6 28
- C7/T1 4
- Thoracic 14
- Lumbar 5

The Problem

26 mismanaged patients

- **7 developed a deficit**
- **19 deteriorated, 9 to complete paralysis**
- **6 died**

The Problem

Associated features (52 patients)

- 36 multiple trauma
- One third significant head injury
- 13 early ventilation
- 9 alcohol
- 7 “hysteria”

The Problem

Radiological features (52 patients)

- 18 poor quality
- 11 failure to demonstrate whole region
- 4 of uninjured region
- 10 unrecognised soft tissue swelling
- 6 no vertebral injury

THINK SPINAL INJURY

Think Spinal Injury

- **Road traffic accident**
- **A fall or jump from a height**
- **Impact or crash injuries**
- **Multiple trauma**
- **Loss of consciousness**
- **Back or neck pain or guarding**

Distribution of Spinal Fractures in a Major Centre

Region	Distribution	Neuro-deficit
Cervical	62 %	75 %
T1 - T10	15 %	88 %
T11 - L2	20 %	70 %
L3 - L5	3 %	59 %
Sacrum	0.3 %	100 %

Multiple Fractures

Occur in 4.5 percent

Three major patterns :-

- | | |
|--------------------|------------------|
| – Primary C 4-7 | Secondary T11-L5 |
| – Primary T 1-4 | Secondary C1-7 |
| – Primary T 12- L2 | Secondary L4-L5 |

CARE OF ACUTE SPINAL CORD INJURY

Handling Cord Injury Patient

- **Neutral supine position**
- **Immobilise Cervical Spine**

Breathing - Observation

- Presence, rate & depth of respiration's
- Asymmetry of the chest
- Paradoxical breathing in cervical injuries

What ?

Paradoxical Breathing

- **Breathing IN**
- **Diaphragm contracts**
- **Chest drawn IN**
- **Abdomen pushed OUT**
- **Breathing OUT**
- **Diaphragm relaxes**
- **Chest recoils OUT**
- **Abdomen falls IN**

Breathing - Observation

- Presence, rate & depth of respiration's
- Asymmetry of the chest
- Paradoxical breathing in cervical injuries
- **What can't a high spinal cord injured patient do?**

Breathing - Observation

- **Presence, rate & depth of respiration's**
- **Asymmetry of the chest**
- **Paradoxical breathing in cervical injuries**
- **Cough impaired in cervical & thoracic injuries**
- **Which Means?**

Breathing - Observation

- **Presence, rate & depth of respiration's**
- **Asymmetry of the chest**
- **Paradoxical breathing in cervical injuries**
- **Cough impaired in cervical & thoracic injuries**
- **Increased risk of aspiration and consolidation of secretions**

Breathing - Action

- **Continuously monitor oxygen saturation levels**
- **Monitor and maintain Sa O₂ - 95% or above**
- **Administer oxygen**
- **Dry O₂ for short term use only. If longer O₂ required then it should be humidified**
- **Monitor blood gases regularly**
- **Elective ventilation may be needed**

Deterioration of Respiratory Function

Why ?

Deterioration of Respiratory Function

- **Fatigue of innervated muscles**
- **Chest trauma**
- **Ascension of spinal cord lesion**
- **Retained secretions**

Intubation

- Neutral cervical position
- **BEWARE Vaso-Vagal shock (What?)**

Vaso-Vagal Shock

- **Interruption sympathetic control**
- **Sympathetic Outflow ?**
- **Sensory distribution of Vagus ?**
- **Blood pressure falls - loss of vasomotor control**
- **Heart rate slows - unopposed action of vagus nerve**

Intubation

- Neutral cervical position
- **BEWARE Vaso-Vagal shock**
- **What precautions?**

Intubation

- **Neutral cervical position**
- **BEWARE Vaso-Vagal shock**
- **Pre-oxygenate**
- **Hyperventilate**
- **Topical anaesthetic**
- **Atropine – How Much ?**

Intubation

- **Neutral cervical position**
- **BEWARE Vaso-Vagal shock**
- **Pre-oxygenate**
- **Hyperventilate**
- **Topical anaesthetic**
- **Atropine – 0.3 – 0.6 mg**

Neurogenic Shock

- **Interruption sympathetic control**
- **T6 and above**
- **Blood pressure falls - loss of vasomotor control**
- **Heart rate slows - unopposed action of vagus nerve**
- **BEWARE concealed blood loss in anaesthetic patient**

Neurogenic Shock

- Hypotensive
- Bradycardic pulse of good volume
- Peripherally warm and dry
- **What is normal blood pressure in a tetraplegic?**

Circulation - Action

- **Monitor BP**
- **Maintain a systolic BP of 90 - 100 mmHg**
- **Urinary output of 30 mls per hour**
- **Administer IV fluids**
- **NB. DO NOT over infuse**
- **Inotropes may be necessary**
- **How to Monitor?**

Circulation - Action

- **Monitor BP**
- **Maintain a systolic BP of 90 - 100 mmHg**
- **Urinary output of 30 mls per hour**
- **Administer IV fluids**
- **NB. DO NOT over infuse**
- **Inotropes may be necessary**
- **CVP line may be indicated**

Circulation - Observation

- **Bradycardia**

Action ?

Circulation - Action

- **Rate < 40 - Atropine** **How Much ?**
- **BEWARE Abnormal Vaso-Vagal response**
 - Logrolling too quickly
 - tracheal suction
 - N.G. tube
- **Thoracic injuries - cardiac contusion - arrhythmia**

Circulation - Action

- **Rate < 40 - Atropine 0.3 – 0.6 mg**
- **BEWARE Abnormal Vaso-Vagal response**
 - **Logrolling too quickly**
 - **tracheal suction**
 - **N.G. tube**
- **Thoracic injuries - cardiac contusion - arrhythmia**

Pressure Sores

Causes ?

Pressure Sores

- **Lack of sensation**
- **Lack of muscle activity below the level of injury**
- **Reduced microvascular circulation**

Skin - Observation

- **Check all pressure areas for any possible causes of local pressure**

Skin - Action

- **Remove any objects from patients clothing**
- **Logroll patient to remove foreign bodies**
- **Heels vulnerable, use a small pillow**
- **Spinal board - two hours maximum**
- **Pressure relief 2 hourly**
- **BEWARE removing straps with head huggers in situ**
- **Protect risk areas at all times**

Temperature

Problem ?

Temperature

- **Neurogenic shock - dilated vessels - lose heat**
- **Inability to shiver**
- **Hypothermia**

Temperature - Action

- **Sheet, space blanket then blankets**
- **BEWARE fire risk oxygen and space blankets**

Paralytic Ileus - Observation

- **Listen to abdomen for presence of bowel sounds**
- **Observe for abdominal distension**
- **Potential risk of stress ulceration**

Action ?

Paralytic Ileus - Action

- **Nil - by - mouth**
- **Naso-gastric tube - free drainage**
- **Administer Cimetidine or Ranitidine intravenously**

Bladder - Observation

- **Avoid over-distension of the bladder**

Bladder - Action

- **Insert foley catheter - free drainage**
- **Priapism - do not attempt urethral catheterisation**
- **Supra-pubic catheter (How ?)**

Neurological Examination

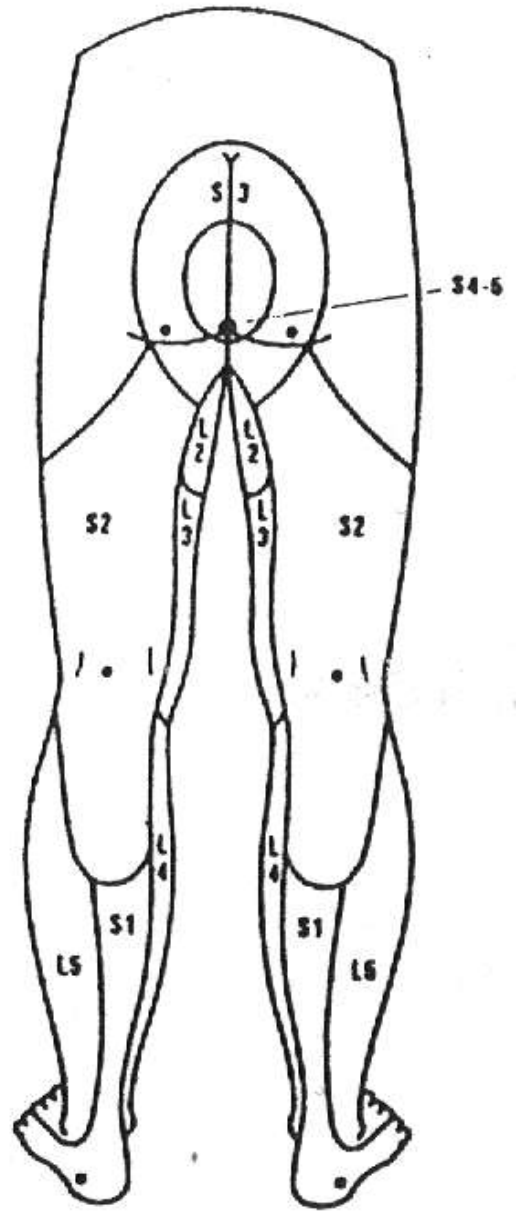
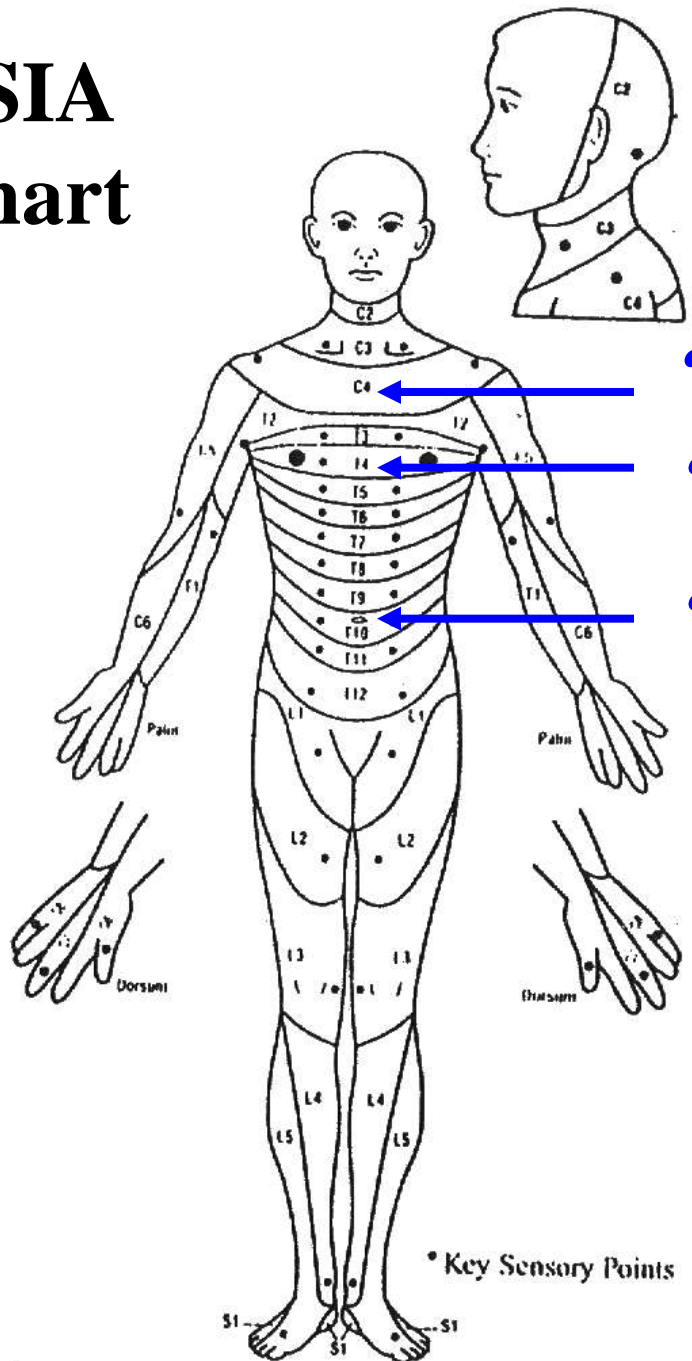
Sensation

0 Absent

1 Altered

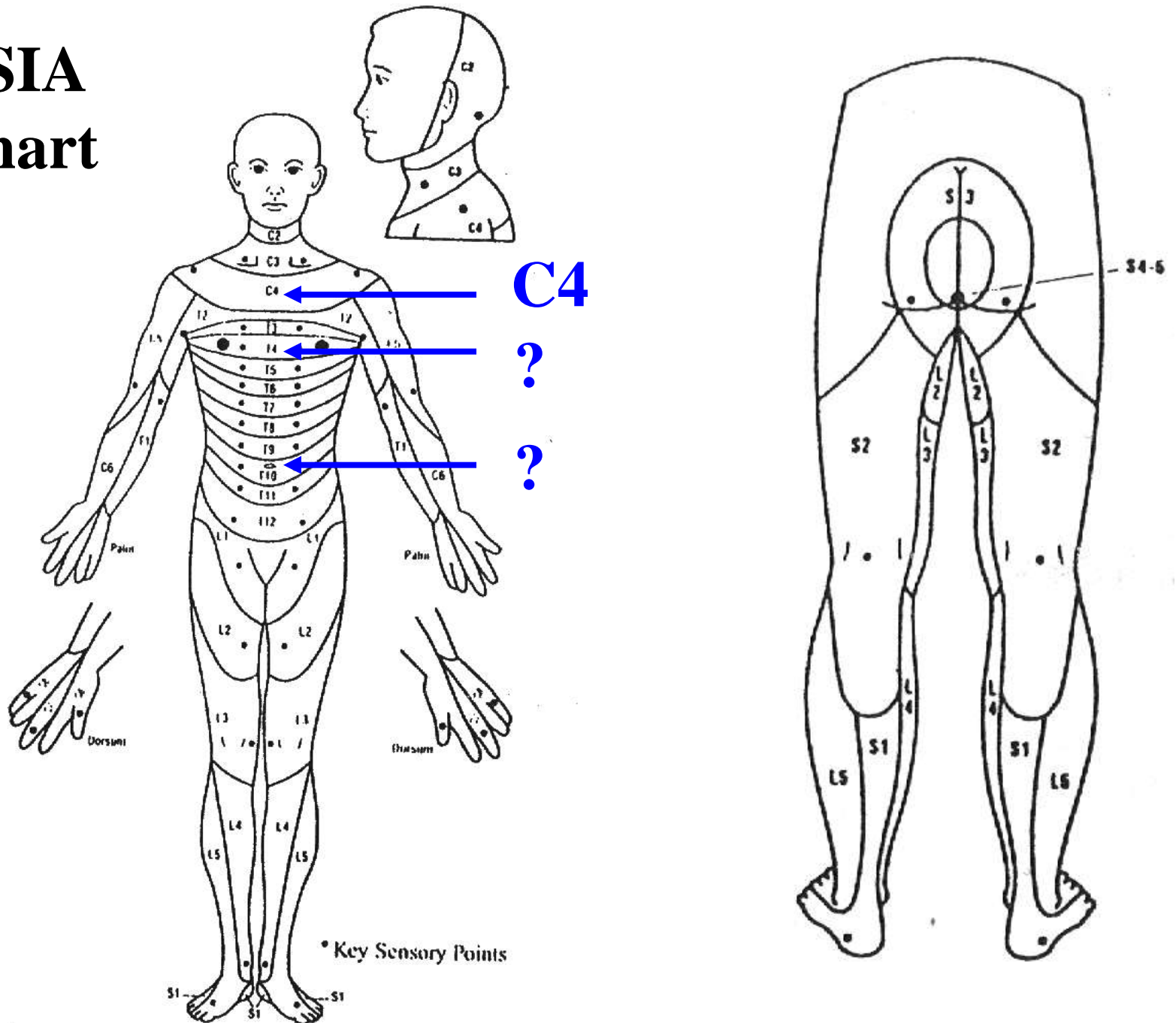
2 Normal

ASIA Chart

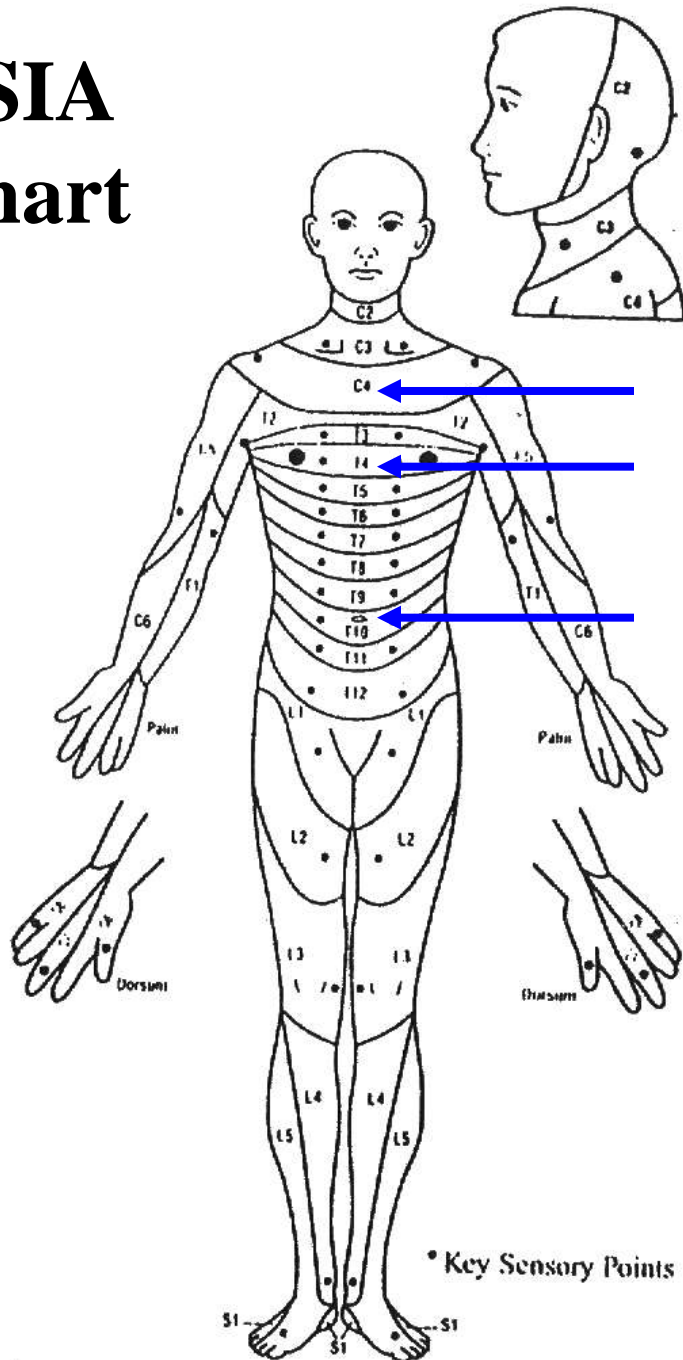


• Key Sensory Points

ASIA Chart



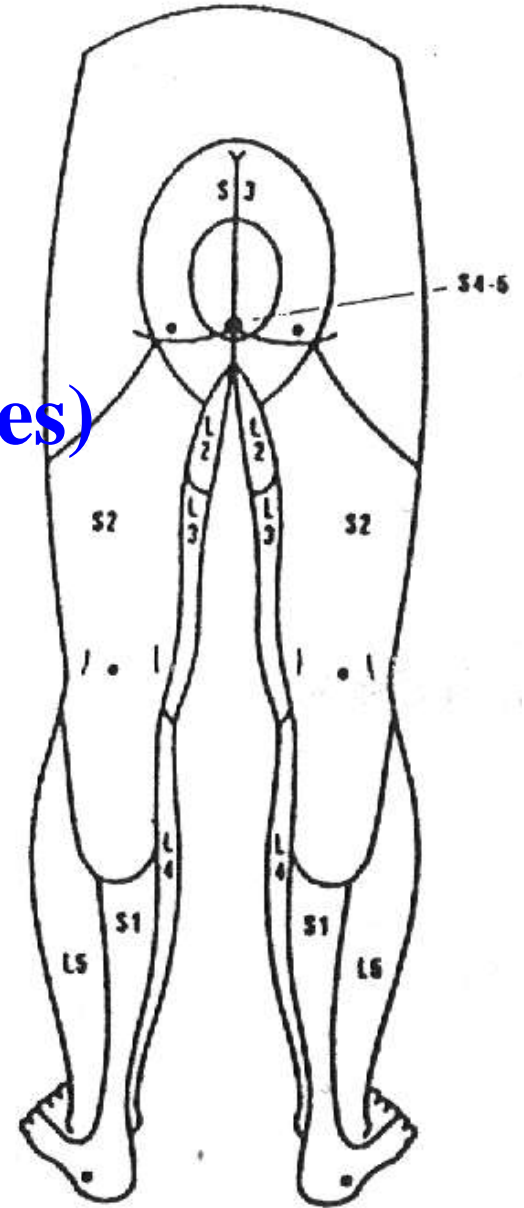
ASIA Chart



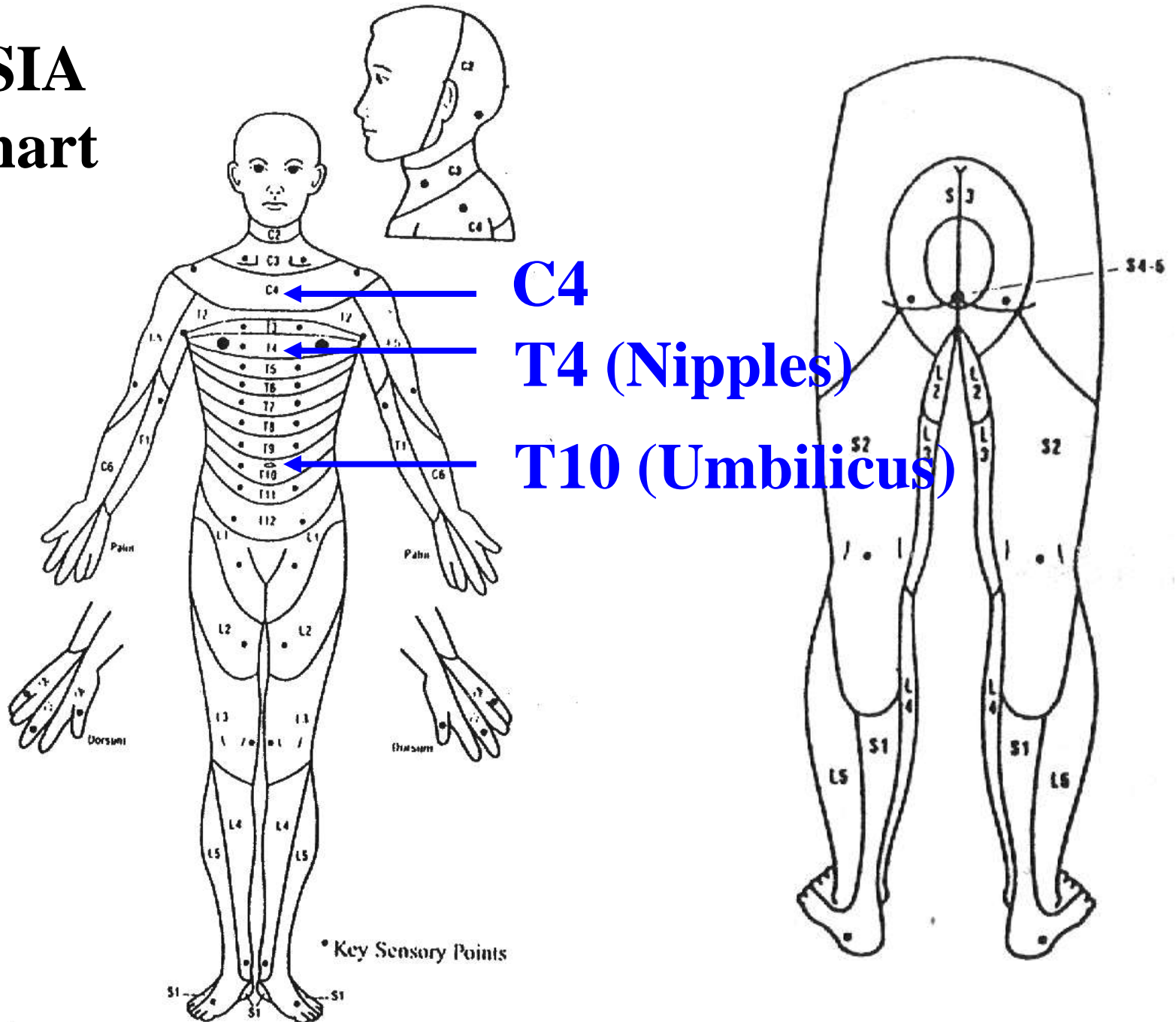
C4

T4 (Nipples)

?



ASIA Chart



The Spinal Cord

Motor

0 None

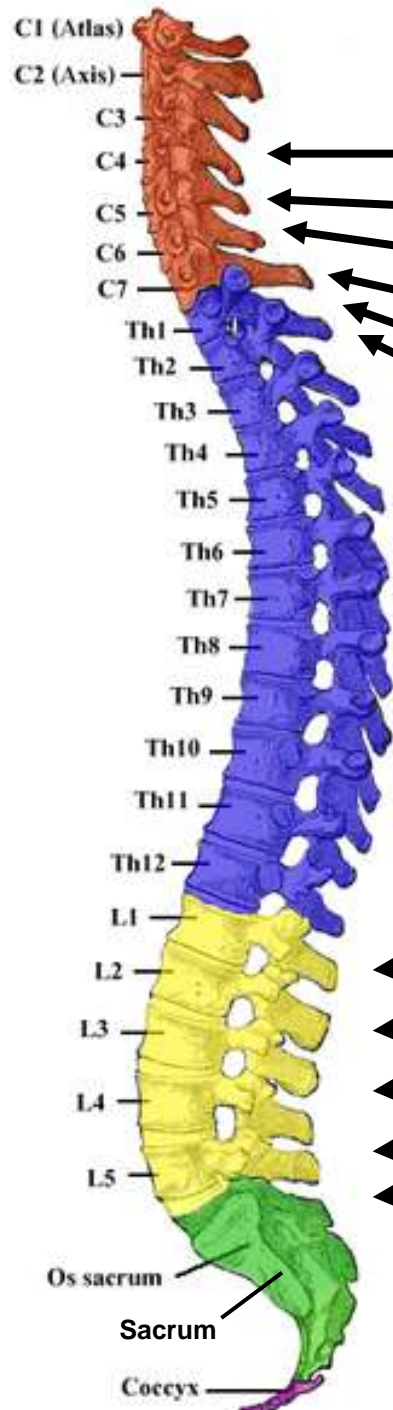
1 Flicker

2 Movement, gravity eliminated

3 Movement, against gravity

4 Movement, against resistance

5 Full Power



Somatic

C3, C4, C5 Diaphragm

C5 Deltoid, Biceps

C6 Wrist extension

C7 Elbow extension (Triceps)

C8 Finger Flexion (grip)

T1 Small hand muscles

T2-T6 Intercostals,
Trunk above waist

T7- L1 Abdominals,
Lower trunk

L2 Hip Flexion

L3 Knee Extension

L4 (L5) Ankle Dorsiflexion

L5 Extension Big Toe

S1 Ankle Plantar Flexion

S3 - S5 Pelvic Floor,
External Sphincters

ASIA Chart Upper Limb and Trunk

Date							
Time	Motor		Touch		Pain		
MOTOR	R	L	R	L	R	L	
Shoulder Elevators C3, 4					2	2	C2
Abductors C5, 6					2	2	C3
Adductors C5-T1					2	2	C4
Elbow Flexors <u>C</u> 5,6	5	5			2	2	C5
Elbow Extensors <u>C</u> 7, 8,T1	3	3			2	2	C6
Wrist Flexors C6,7,8					1	1	C7
Wrist Extensors <u>C</u> 6, 7,8	5	5			0	0	C8
Finger Flexors C7, <u>8</u> ,T1	0	0					
Finger Extensors C7,8					0	0	T1
Hand Intrinsic C8,T1					0	0	T2
Thumb Flexors C7,8,T1					0	0	T3
Thumb Extensors C7,8					0	0	T4
ABD. DIG. MIN C8, <u>T</u> 1	0	0			0	0	T5
Abdominal Muscles: Upper					0	0	T6
Lower					0	0	T7

ASIA Chart Lower Limb

Time	Motor		Touch		Pain		
MOTOR	R	L	R	L	R	L	
Hip Flexors <u>L2, 3</u>	0	0			0	0	T8
Extensors <u>L5,S1,2</u>					0	0	T9
Abduct. <u>L4,5,S1</u>					0	0	T10
Adduct. <u>L3,4</u>					0	0	T11
Knee Flexors <u>L4,5,S1,2</u>					0	0	T12
Knee Extensors <u>L2, 3,4</u>	0	0					
Ankle DF <u>L4, 5,S1</u>	0	0			0	0	L1
PF <u>S1,2</u>	0	0			0	0	L2
Toe Flexors <u>L5, S1,2</u>					0	0	L3
Extensors <u>L4,5,S1</u>	0	0			0	0	<u>L4</u>
					0	0	L5
<u>REFLEXES</u>							
					0	0	S1
ASIA SCORE					0	0	S2
Total ASIA score	26	/100			0	0	S3
					0	0	S4-5

ASIA Chart Upper Limb and Trunk

Date							
Time	Motor		Touch		Pain		
MOTOR	R	L	R	L	R	L	
Shoulder Elevators C3, 4					2	2	C2
Abductors C5, 6					2	2	C3
Adductors C5-T1					2	2	C4
Elbow Flexors <u>C5,6</u>	5	5			2	2	C5
Elbow Extensors <u>C7, 8,T1</u>	3	3			2	2	C6
Wrist Flexors C6,7,8					1	1	C7
Wrist Extensors <u>C6, 7,8</u>	5	5			0	0	C8
Finger Flexors C7, <u>8</u> ,T1	0	0					
Finger Extensors C7,8					0	0	T1
Hand Intrinsic C8,T1					0	0	T2
Thumb Flexors C7,8,T1					0	0	T3
Thumb Extensors C7,8					0	0	T4
ABD. DIG. MIN C8, <u>T1</u>	0	0			0	0	T5
Abdominal Muscles: Upper					0	0	T6
Lower					0	0	T7

Level ?

ASIA Chart Upper Limb and Trunk

Date							
Time	Motor		Touch		Pain		
MOTOR	R	L	R	L	R	L	
Shoulder Elevators C3, 4					2	2	C2
Abductors C5, 6					2	2	C3
Adductors C5-T1					2	2	C4
Elbow Flexors <u>C5,6</u>	5	5			2	2	C5
Elbow Extensors <u>C7, 8,T1</u>	3	3			2	2	C6
Wrist Flexors C6,7,8					1	1	C7
Wrist Extensors <u>C6, 7,8</u>	5	5			0	0	C8
Finger Flexors C7, <u>8</u> ,T1	0	0					
Finger Extens						0	T1
Hand Intrinsic						0	T2
Thumb Flexor						0	T3
Thumb Extens						0	T4
ABD. DIG. MIN C8, <u>T1</u>	0	0			0	0	T5
Abdominal Muscles: Upper					0	0	T6
Lower					0	0	T7

C6 Complete

Steroids

NASCIS 2

- **Methyl prednisolone 30 mg/Kg** **162**
- **Naloxone 5.4 mg/Kg** **154**
- **Placebo** **171**

Steroids

**NASCIS 2 – All data, intention to treat
Methyl pred Vs. Placebo**

	6/52	6/12	12/12
Motor	n.s.	n.s.	n.s.
Sensory	n.s.	p < 0.05	n.s.

Steroids

**NASCIS 2 – Delivered < 8 hours, one year,
percentage recovery of lost motor function**

	Methyl pred.	Placebo	
Complete	7.0	1.6	n.s.
Incomplete	44.1	20.7	p < 0.05

Steroids

NASCIS 2 – Incomplete lesions, one year,
percentage recovery of lost motor function

	Methyl pred.	Placebo	
< 8 hours	44.1	20.7	p < 0.05
> 8 hours	34.1	48.5	p < 0.05
	n.s. ?	p < ??	

Best Buy !

Steroids

Two Other RCT s

- **Petitjean et al 1998**
- **Otani et al 1994**

- **No differences observed at one year**

Steroids

Complications

- **Infection**
- **Perforated DU**
- **Hyperglycaemia**
- **etc.**

Steroids

**British Association of Spinal Cord Injury
Specialists, June 2000**

**The use of high dose steroids in the
management of spinal cord injury cannot
be supported on current evidence**

CONTRA INDICATED

Anticoagulation

- **Prophylaxis mandatory**

Surgical Management

- **Initial Stabilisation**
- **Decompression**
- **Surgical Stabilisation**

Initial Stabilisation

- **Cervical Traction**
- **Regular detailed neurological examination**

Surgical Management - Decompression

- Some Neurological recovery invariable in incomplete lesions**
- Recovery by at least 1 ASIA grade is normal**

Neurological Recovery

- **Surgery < 24 hours is safe**
- **Reduction of dislocation early (4 Hours) improves Neurology**
- **Surgery < 24 hours reduces ITU stay and complication rate**
- **Effect < 12 hours (Tator) ?**
- **STASCIS Trial early results favourable**

**Fehlings and Perrin, Systematic Review, SPINE 31: S28–
S35, 2006**

Cord Decompression

Mandatory

- Major Disc Fragments**
- Incomplete Lesions In Kyphosis**
- Cauda Equina**
- Deteriorating Neurology**

Surgical Stabilisation

- **Cord injury requires modified technique**
- **No muscle protection**
- **Two up, two down**
- **Front AND back**

C 4/5 Bifacetal Dislocation



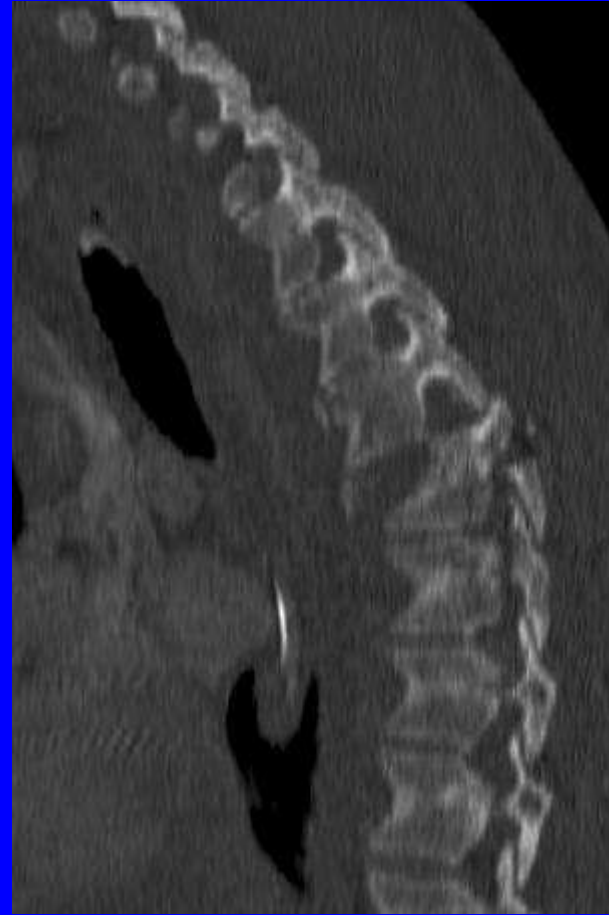
C 4/5 Bifacetal Dislocation



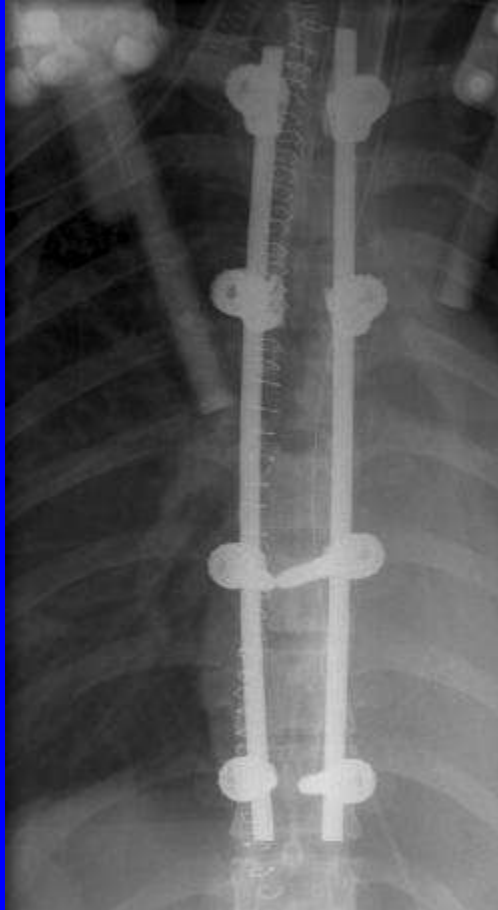
Post Operative



T 6/7 Injury



Post Operative



Surgical Stabilisation

- **Reduces co-morbidity**
 - ITU days, ARDS, duration of ventilation
 - (Halo jacket reduces breathing by 50 %)
- **Safe in experienced hands**
- **Allows early mobilisation**
- **Reduces pain on turning**
- **Reduces late deformity / syrinx**
- **Reduces nursing load**

Surgical Stabilisation

Requires

- **Experienced Spinal Surgeon**
 - **MUST allow un-braced mobilisation**
- **Experienced Anaesthetist**
- **Highly skilled nurses**
- **Major spinal surgery centre**
- **Spinal surgeons should see results**

Surgical Stabilisation

- **Complications of Surgery**
 - **Anaesthesia (Most dangerous time ?)**
 - **Neurological deterioration**
 - **Infection**
 - **Wound Healing**
 - **Instrumentation**
 - » **Misplaced**
 - » **Inadequate**

Mobilisation

- The area of necrosis will be surrounded by an area of impaired perfusion
- The acute injury
MUST BE NURSED FLAT
- Subsequent mobilisation must be preceded by tilt tabling and careful neurological observation

Surgical Stabilisation

Complications of Management

- **Pressure Sores can take weeks of bed rest to heal, completely negating value of surgery**
- **Bowel management is usually poor**
- **ITU care of skin and bowel often lacking**

Pressure Sore

Ward	Grade	Site of sore	Level of Injury	Date of Injury	Date of Referral	Date of Admission	Total Bed rest days	Bed rest at home	Mobilisation date
ITU NGH	4	Sacrum, Buttock, Heels	T 10	23/12/08	16/01/09	16/01/09	165	83	03/07/2009
Days to - Total Days					24	0 24			



Mobilisation

- **To allow a cord injured patient to sit on a pressure sore is**

negligent management

Spinal Injuries Association UK

Conclusion

- **Spinal Cord Injured Patients are extremely vulnerable and are best managed in a spinal cord injury bed**
- **Telephone advice and outreach liaison are always available from your local friendly spinal cord injury centre**



THANK YOU