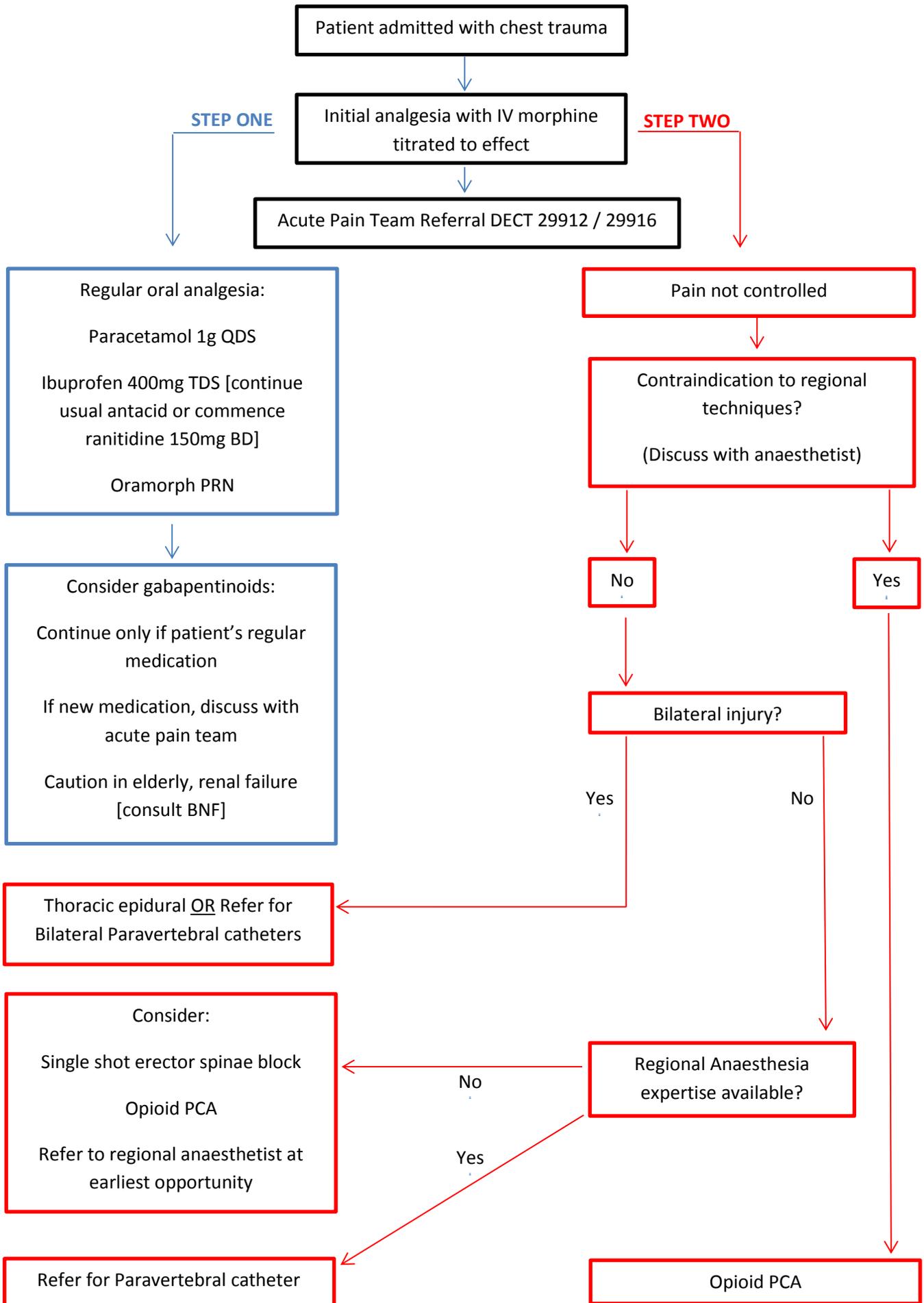


NUTH RVI Chest Trauma Analgesia Pathway



The Newcastle upon Tyne NHS Foundation Trust

Management of Blunt Thoracic Trauma – Main Recommendations

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Expiry Date:	
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Ratified By:	NUTH RVI Trauma Peer Review Group

1. Scope of guideline

This clinical guidance relates to patients who have sustained blunt chest trauma and as a result have threatened or actual respiratory failure secondary to injury to the chest wall and/or underlying lung.

Out with its scope are major non respiratory sequelae to chest injury including:

- Cardiac and great vessel injury
- Major haemothorax
- Mediastinal injury
- Injury to the diaphragm, oesophagus, tracheobronchial tree or spine

2. Main Recommendations

2.1 Initial Management

Patients with blunt chest trauma will be managed in a standard fashion within the context of the well-established trauma systems at the RVI. Specific points relating to chest injury include:

- Application of high flow O₂
- Intercostal drainage of pleural collections of blood and air at the direction of the trauma team leader
- The immediate assessment by the attending anaesthetist / intensivist regarding requirement for intubation and ventilation
- The early provision of adequate analgesia, most usually intravenous morphine
- Imaging – CXR or CT if NUTH criteria for trauma CT are met

If CT chest is performed, radiology should be asked to generate 3D rendered images to assist chest wall injury assessment and operative decision making. (Note: data to perform this is not stored on PACS beyond 7 days).

2.2 Place of Care

The triage decision for this injury is essentially between management on the trauma ward (Ward 23) or on critical care (Ward 18). For many patients this will be a straightforward decision depending on other injuries, presence and severity of respiratory failure and requirement for support but a borderline group of patients requires thought and team discussion.

→ ***It is the responsibility of the ED Consultant to decide if the patient should be admitted to Ward 23 or referred to Ward 18 Critical Care***

Major Indications for triage to Ward 18 Critical Care include:

Group 1 - Clear cut indication for critical care:

- Other traumatic injury requiring organ support
- Respiratory Failure requiring support from the outset

Group 2 - Elderly and/or chronic CVS/ RS disease plus significant injury

- 4 rib fractures **PLUS** one or more of:
 - Age >65
 - Chronic lung disease
 - Cardiovascular disease in particular coronary artery disease or known reduced ventricular function

Group 3 – Signs of impending/threatened respiratory failure

- PaO₂ <8 kPa, SaO₂ <92% on high flow O₂ therapy
- Hypercapnia – PaCO₂ > 6.5 kPa
- Evidence of increased work of breathing – respiratory rate >20, use of accessory muscles, unable to speak in sentences
- Poor deep breathing/coughing despite appropriate analgesia
- Radiological evidence of significant early pulmonary contusion

Critical Care review for admission is via the ORANGE on call anaesthesia trainee (29999) or the on call Ward 18 ITU consultant (via switchboard).

2.3 Responsible Clinical Team and Specialty Review

On Ward 23, all patients will be under the care of the responsible Emergency Medicine consultant.

On Ward 18 the patient will be under the care of the responsible Critical Care consultant.

→ ***All patients admitted to Ward 23 with chest injury should be reviewed daily by an appropriate member of the critical care team.***

This should be at consultant level initially and ideally by the same individual over the course of the ward stay. The Emergency Medicine team should inform the Ward 18 Critical Care team of the presence of a chest injury patient on Ward 23 (Ward 18 resident – 21816, or Consultant).

→ ***Patients deteriorating on Ward 23 and meeting criteria for ED triage to Ward 18 as outlined above should be referred urgently to ORANGE on call.***

This referral should be made by the ED SHO doctor (Dect 21763).

→ ***All patients on Ward 18 and 23 with ≥ 4 rib fractures should be reviewed by the orthopaedic trauma team within 48 hours for assessment of suitability for operative rib fixation.***

Any member of the multidisciplinary team can make this referral. Please see section 2.8 for details.

The usual route of discharge from Ward 18 should be to the Trauma Ward, Ward 23. A certain subset of patients within ongoing respiratory issues may benefit from admission to respiratory medicine, particularly those with pre-existent lung disease.

Most chest trauma patients will need a form of outpatient follow-up. There are several clinics available and any patient can be referred to one or more of these as deemed appropriate by the Consultant in charge. These clinics are:

1. **Soft Tissue Injury Clinic** – Suitable for patients with underlying lung injury.
2. **Major Trauma Rehabilitation Clinic** (CRESTA Outpatients) – Suitable for patients with complex rehabilitation needs. Patients can be directed to Dr Laura Graham, Consultant in rehabilitation medicine.
3. **Intensive Care Follow-up Clinic** – Suitable for patients who have undergone long / complex critical care admission. Referrals are to Dr Kaye Cantlay, Consultant in intensive care.
4. **Patients own General Practitioner** – Suitable for patients with rib injury but without underlying lung injury.

2.4 Analgesia

Analgesic management should follow the pathway as outlined on page 1.

→ ***All chest trauma patients should be referred to the acute pain team on admission***

This referral can be made by any member of the multidisciplinary team via DECT 29912 / 29996.

2.4.1 Oral / Intravenous Analgesia

→ ***All chest trauma patients should receive early strong analgesia – usually intravenous morphine.***

→ ***All patients should receive regular oral or intravenous paracetamol.***

NSAIDs have been studied in chest trauma patients and have been associated with lower opioid requirements, improved pain scores, decreased frequency of pneumonia, and more critical care and ventilator free days (Bayouth et al, *Am Surgery*, 2013 and Yang et al, *Am J Surg*, 2014)

→ ***All patients should be assessed for appropriateness of NSAID treatment.***

→ ***Patients without a contra-indication to NSAID therapy should receive one, e.g. ibuprofen 400mg TDS PO or naproxen 500mg BD PO.***

→ ***Any usual gut prophylaxis treatment should be continued, or should be initiated using ranitidine 150mg BD PO.***

Chronic pain in rib fracture patients has been studied. In one sample of 203 patients the prevalence of chronic pain was 22%, with a strong association with the intensity of pain within the first two weeks and with bilateral fractures (Gordy et al, *Am J Surg*, 2014).

Gabapentin and pregabalin are used as adjuncts in acute pain management, particularly perioperatively. There is little evidence available with regard to the effect of its acute use on the incidence of chronic pain. A meta-analysis (Clarke et al, *Anaes Analg*, 2012) found that 6 out of 8 gabapentin studies demonstrated a moderate to large reduction in the development of chronic post-

surgical pain, and 2 out of 3 pregabalin papers found a very large reduction in the same outcome measure.

- ***Patients taking gabapentin or pregabalin should continue to receive these drugs.***
- ***Patients with inadequate pain control should be discussed with the acute pain team with regard to the initiation of one of these agents, due to their cautions and side effect profiles.***
- ***Dosage will need to be amended in renal impairment, and if excessive somnolence occurs. Refer to BNF.***

There is a “gabapentin initiation order set” available on e-record to assist in commencing this medication in suitable patients.

2.4.2 Regional Techniques

- ***All patients admitted to NUTH (Ward 18 and 23) with significant chest trauma with significant pain arising from one or more rib fractures should be assessed by an anaesthetist within 24 hours of admission or sooner if possible for consideration of a continuous regional analgesic technique.***

This may be achieved by:

- Monday – Friday 0900 – 1600 – ring Regional Anaesthesia DECT 21806
- Out of hours/ weekends – ring PINC on call anaesthesia - 29214

Most contraindications to regional techniques for chest trauma are **relative**, and we advise discussing individual cases with a consultant regional anaesthetist.

General contraindications to regional techniques for chest trauma include:

- Patient refusal
- Overlying localised infection
- Abnormal anatomy (scoliosis, tumour etc)
- Allergy to local anaesthetic

Specific contraindications to regional techniques vary depending on the exact technique in question:

- Paravertebral – total pleurectomy
- Epidural – coagulopathy (refer: [“Protocol for routine use of epidural analgesia \(EPCA\) in adults”](#))

Note: With Paravertebral and Erector Spinae blocks, coagulopathy is a relative contraindication. Individual cases will need to be discussed with a consultant regional anaesthetist.

Continuous regional anaesthetic techniques may both be managed on Ward 23 if no other indication for critical care.

- ***All patients on regional analgesic techniques or requiring morphine PCA should be referred to the acute pain team – 29912 or 29996.***

2.5 Respiratory Support

2.5.1 Ward 23

- **All patients without history of hypercapnic respiratory failure should have supplemental O₂ therapy titrated to a target SaO₂ of 94 – 98%.**

The majority of these patients will receive 2-6l/min O₂ via variable performance device, e.g. Hudson mask, or nasal cannula.

- **Patients with a history of hypercapnic respiratory failure should have supplemental oxygen to target SaO₂ 88-92%.**

The majority of these patients will require 1-2 L/min via nasal cannula or a fixed performance device i.e. Venturi mask.

- **Simple facemasks (Hudson masks) should not be used in Type 2 respiratory failure patients and should not be used with less than 5 L/min to prevent rebreathing and CO₂ build up.**

- **Humidified oxygen should be provided to patients that:**

- **Require prolonged oxygen therapy at high flow rates (greater than 2L/min via nasal cannula or greater than 6 L/min by facemask) for longer than 24 hours**
- **Report airway discomfort due to drying,**
- **Are at risk of sputum retention**

- **When humidification is required, this should be provided by large nebuliser based systems, which allow delivery of a fixed fraction of inspired oxygen.**

- **Bubble based humidification systems should not be used due to lack of benefit and risk of infection.**

High Flow Nasal Cannula can provide humidified oxygen with improved patient comfort and offers the advantage of a CPAP effect.

- **High Flow Nasal Cannula should also be considered early for chest trauma patients with any one or more of:**

- **Pre existing respiratory comorbidity***
- **Lung injury**
- **Acute respiratory infection**
- **Increasing work of breathing**
- **Requiring greater than 40% O₂**
- **Increasing oxygen requirements**
- **Deteriorating blood gases**

* Take care when titrating oxygen to variances for patients with known CO₂ retention

Please refer to NUTH guideline "[The Use of High Flow Nasal Cannula/ AirVo](#)" on the Trust Intranet.

(BTS guideline, May 2017)

2.5.2 Critical Care

- ***Heated humidified gases should be administered.***
- ***Early use of CPAP should be used to prevent pulmonary complications and reduce the likelihood for requiring formal mechanical ventilation.***

High flow Nasal Cannula may be an effective alternative to facial CPAP in certain individuals and should be considered, particularly in those patients unsuited to the CPAP face mask or hood.

Pre-emptive invasive or non-invasive ventilation is not effective. Decisions for institution of respiratory support should be based on usual criteria relating to gas exchange and work of breathing.

There is no specific evidence demonstrating benefit or not of NIV in this patient group.

- ***Invasive ventilation should follow a best practice ARDS model of open lung, limited tidal volume.***
- ***Early tracheostomy should be considered.***

High frequency oscillation may be considered in those patients failing conventional modes of support but this mode of ventilation has not been shown to demonstrate a survival benefit in ALI/ARDS.

Rescue therapies for those in who adequate gas exchange is proving impossible include:

- Extra-corporeal gas exchange systems
- One lung ventilation – may improve V/Q matching
- ECMO – requirement for full anti-coagulation may be problematic in the setting of trauma
- High Frequency Oscillatory Ventilation

2.6 Fluid Management

- ***Patients with blunt chest injury should not be excessively fluid restricted but should be resuscitated to maintain signs of adequate tissue perfusion.***

Initial fluid resuscitation should be with crystalloid or blood products at the direction of the trauma team leader and subsequent medical team.

Following initial resuscitation, unnecessary fluid administration should be avoided and an even fluid balance targeted.

An appropriate diuretic regime may be utilised to achieve this goal.

2.7 Respiratory Support

2.7.1 General Principles

The goals of physiotherapy are to maintain lung volume, prevent and treat lung collapse and consolidation, aid secretion clearance and facilitate mobilisation.

Of note, physiotherapy techniques are unlikely to be possible/ effective if there is inadequate analgesia.

During weekday working hours, physiotherapy will see those patients admitted to Ward 18/23 without need for specific referral.

- ***At weekends, contact the respiratory physio team on admission, or, for Ward 23 patients, when reviewed by the Trauma or Critical Care teams.***
- ***Patients should be seen by physiotherapy at least twice per day in the first 48 hours.***

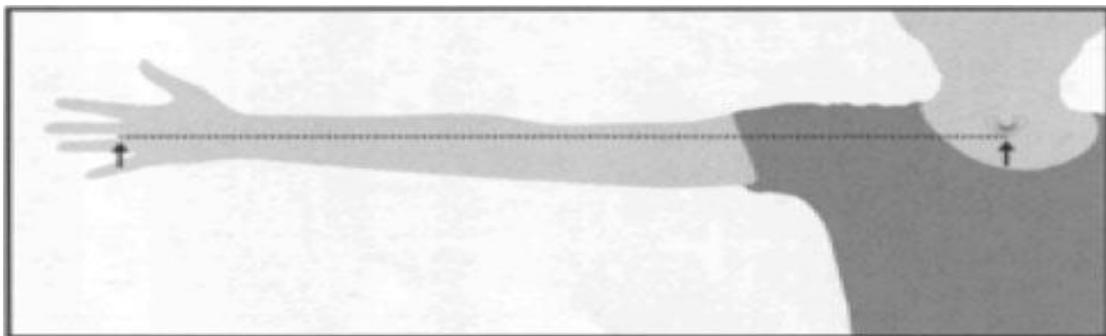
2.7.2 Pain, Inspiration, Cough (PIC) Scoring

Bedside spirometry is a simple to perform bedside measure of pulmonary function that is already being used in chest trauma patients at RVI. Bedside vital capacity has been shown to correlate with length of stay and discharge to an extended care facility, albeit in a small study (Bakhos et al, J Trauma, 2006)

The PIC score was originally developed Wellspan York Hospital, Pennsylvania USA and has subsequently been adopted by the Harborview Medical Centre (level 1 trauma centre managing 4500 blunt chest trauma patients annually). It is used to serially evaluate and monitor chest trauma patients and guide management decisions. Its use in chest trauma patients at Wellspan resulted in a reduction in length of stay and improved rates of discharge to home. A further study at Harborview Medical Centre, Washington, has demonstrated the implementation of a chest trauma pathway involving PIC scoring results in decrease in ventilator days, length of stay, infectious complications and mortality (Todd et al, Am J Surg, 2006).

PIC Scoring requires a Goal Inspiratory Capacity (IC) to be prescribed. This is calculated as 80% of the patients Expected IC, based on standard nomograms for height, age and sex.

An Alert IC is then calculated at 15ml/kg of Ideal Body Weight (IBW). IBW is calculated by measuring the patient's demispan and looking this up in a standard table.



To calculate the IBW:

With the patient's arm outstretched and horizontal in line with the shoulders, measure (in cm) from the sternal notch to the web between the middle and ring finger, with the wrist in neutral rotation and zero extension or flexion.

Use the demispan, together with the patients age and sex and the table on the back of the PIC chart, to find reference values for Goal and Alert IC.

Patients with COPD do not require further adjustment of these values

Patients with high spinal cord injuries are exempt from PIC scoring.

Chest pain should be assessed as the patient performs incentive spirometry ie a dynamic pain score should be obtained.

	Chest Pain	Inspiratory Capacity	Cough
1 point	Severe (8-10)	Unable to perform	Absent
2 points	Moderate (5-7)	Below alert	Weak
3 points	Mild (0-4)	Between alert and goal	Strong
4 points		Above goal	

Adapted Harborview Medical Center PIC Scoreboard, originally by Wellspan York Hospital, Pennsylvania USA

- ***Ward 23 and Ward 18 (HDU) patients should undergo PIC scoring four times per day.***
- ***Intensive Care patients should begin PIC Scoring after extubation.***
- ***PIC scoring can be performed by physiotherapists or nursing staff.***
- ***When physiotherapists are not available, ward staff should issue incentive spirometers to new patients and provide education on their use.***
- ***Spirometry values and PIC scores should be recorded on the PIC proforma, which is filed in the nursing notes at the bedside. These should be reviewed regularly by medical teams on ward rounds.***
- ***A score of 1 in any category (after interventions) should prompt discussion with the parent medical team****

* Interventions include providing all available prescribed analgesia to patients who are scoring 1 for pain, prior to contacting the medical team.

2.8 Operative Rib Fixation

There are currently no published practice management guidelines for operative fixation in rib fracture patients.

Meta-analyses of flail chest patients have shown an association with shorter ventilator duration, ITU length of stay and hospital length of stay as well as reduced odds of pneumonia, septicemia, tracheostomy, chest deformity and mortality when operative fixation is undertaken. (Slobogean et al, J Am Coll Surg, 2013 and Leinicke et al, Ann Surg, 2013)

Retrospective studies of patients with rib fractures without flail have demonstrated improved outcomes, but prospective studies are lacking (Cordellie et al, Trauma Surg Acute Care Open, 2017).

In selected patients, operative rib fixation (open reduction) may prevent the development of actual respiratory failure requiring mechanical ventilation or in those already ventilated, may reduce time on the ventilator.

→ **Regardless of respiratory status, all patients admitted with blunt chest injury and ≥ 4 rib fractures on CT should be referred within 48 hours of admission for assessment.**

Any member of the multidisciplinary team can make this referral

Decision making regarding patient selection and timing of surgery is made jointly at consultant level between critical care, orthopaedic and thoracic surgical teams.

Referrals should go to either one of:

Mr John Williams, Consultant Orthopaedic Surgeon
Mr Stephen Aldridge, Consultant Orthopaedic Surgeon
Mr Paul Fearon, Consultant Orthopaedic Surgeon
Thoracics on-call, (via switchboard)

This applies to patients on both Ward 18 and 23.

→ **CXR and 3D rendered images of chest CT should be available at the time of referral.**

(BOA-ST15 guideline, April 2016)

Current broad indications for operative intervention at NUTH include:

- Physiological Flail segment
- Injuries causing respiratory compromise (Multiple single rib fractures contributing in a significant way to pain which limits deep breathing and coughing and/or is contributing significantly to impending/actual respiratory failure)
- Significant chest wall deformity/ rib displacement.
- Where pain control cannot be achieved despite maximal analgesia

Patients who undergo operative fixation will be followed up in the thoracics outpatient clinic.

Authors:

Version 1: Dr A Vincent, Dr MK Varma, Senior Physio R Moses, Mr J Williams

Version 2: Dr A Qureshi, Mrs L Wilkinson, Mr R Clymer, Mrs C Wade, Dr S Platt

