TRAUMA PROTOCOLS / GUIDELINES

On Medical, Surgical and Rehabilitation Management of Expected Injuries during an Earthquake Scenario

Kathmandu, Nepal

November 2011
Trauma Protocol / Guidelines
Developed by
Sainik Punarsthapana Kendra and Handicap International

Prepared under
“Enhancing Emergency Health and Rehabilitation Response Readiness Capacity of Health System in The Event of High Intensity Earthquake in Kathmandu Valley” Project

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Prepared by: Dr. William Homes & Prof. Dr. Pradeep Vaidya

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<td>National Partner:</td>
<td>Sainik Punarsthapana Kendra.</td>
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<td>Activity coordinator:</td>
<td>Handicap International.</td>
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PREFACE BY SECRETARY HEALTH, MOHP
FOREWARD BY HANDICAP INTERNATIONAL COUNTRY DIRECTOR
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<td>Above knee amputation</td>
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<td>DVP</td>
<td>Deep Vein Thrombosis</td>
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<td>Hemoglobin</td>
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<td>NG tube</td>
<td>Nasogastric tube</td>
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<tr>
<td>NISSA</td>
<td>Nerve injury, ischemia, soft tissue and skeletal injury (scoring system)</td>
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<td>NPO</td>
<td>Nil per os</td>
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<td>NS</td>
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<td>Ringer's lactate</td>
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<tr>
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1. BACKGROUND AND OVERVIEW FOR DEVELOPMENT OF TRAUMA GUIDELINES

KATHMANDU VALLEY EARTHQUAKE RESPONSE

Conservative estimates for destruction and devastation should there be an earthquake in the Kathmandu Valley that were comparable with the “Great Bihar Earthquake of 1934” are sobering: 40,000 deaths; 95,000 injured; 60% of buildings destroyed; loss of majority of water, electricity, and other infrastructure support (source: Kathmandu Valley Earthquake Risk Management Project; sponsored by NSET, 1999). In addition, as Kathmandu is the center of Nepal government, defense, police, administrative, as well as international support agencies—coordination and response capacity would be severely affected. As such, the government and partners strive to put some emergency response planning measures in place. A piece of this blueprint includes curative services and physical rehabilitation support for the injured.

Although the specifics of any potential scenario are unpredictable, it must be assumed that baseline medical and rehabilitation services would be overwhelmed—because of number of injured, loss of infrastructure and staff, disruption of communication and transport in the early days; compounded by the subsequent arrival of large volume of regional and international support mechanisms/agencies that though well intentioned, lack coordination and cohesion. The challenges of providing optimal patient care are obvious, and as well, lessons from recent urban disaster scenarios (Haiti earthquake, 2010; Indian Ocean Tsunami, 2004) indicate that less than optimal initial trauma care and treatment may have contributed to morbidity and poor outcomes because of divergent treatment strategies, lack of coordination of activities, and poor continuity of approach. As such, one of the strategies for Disaster Preparedness is to compile some basic therapeutic guidelines of approach for commonly expected injuries (specifically, crush injuries/traumatic amputations, open fractures, spinal injuries).
Recognizing that the scenario for providing treatment will be much different than the normal circumstances, it is important to enlist reference sources and historical experience. Although this is quite limited for the specific scenario of a large scale disaster in a congested urban area, there are a number of accepted international sources that have sought to give guidance for providing treatment under the severely constrained and challenging conditions that would be present: large volume of need, lack of resources, need for non-specialist interventions to be performed by staff working outside of their normal roles and comfort zone, complex injuries presenting many hours/days after the inflicting event, multiple variety of support personnel and assistance coming from outside locations (be it locally, regionally or internationally).

These reference materials include:

1. Primary Surgical Care—Volume 2, Trauma (Maurice King, editor)
2. Surgical Care at the District Hospital (WHO guide)
3. Disaster Management Guidelines—Emergency Surgical Care and Disaster Situations (WHO guide compiled using references 1 and 2, above)
4. ICRC Surgical Guidelines (Revised over many years as an algorithm for giving support in conflict scenarios that offer similar challenges of high volume of patients, limited resources, complex and contaminated wounds presenting late, and wide range of changing clinicians and health staff accustomed to providing care using different approaches).
5. EMERGENCY Hospital(s) Surgical Guidelines (treatment guidelines for providing comprehensive trauma care in low resource, conflict scenarios)
The essence of support is to provide recognized, basic, good wound care and trauma management in the low resource setting—striving to prevent complication, providing for the “best outcome for the largest number of people,” and preserving options for potential future treatment interventions that might further improve outcomes.

As such, an effort is underway to produce some simple, basic guidelines of approach for commonly encountered trauma conditions (crush injuries/traumatic amputation, open fractures, spinal injuries), suitable for the Nepal context, that can be accepted, shared, and instituted among all levels and types of caregivers in case of the challenging scenario of a large scale earthquake in the Kathmandu Valley. It is intended that these guidelines becomes part of the national mass causality strategy document which are being developed by WHO.

It is recognized that among various clinicians and caregivers these will present as a balance and compromise—one intended to provide for consistency of approach so that the multiple caregivers involved—often working with limited resources and outside of their usual locations and realm of responsibility—will have a clear, coordinated and consistent blueprint to follow. It is hoped that this will contribute to providing for best outcomes for the maximum number of patients, limit complications (whether it be as a result of caregivers needing to work beyond their usual roles, or lack of communication and coordination between caregivers and referral sites), and so provide for more coordinated and commonly understood algorithms of treatment.

Lessons from the recent past indicate that the initial interventions (whether they be resuscitation, transport, or treatment actions) play the most significant role in terms of
limiting complications and obtaining best long-term outcomes. If the majority of caregivers are working with cohesion and consistency of approach by utilizing recognized and basic standards, it is hoped that the “lessons learned” from previous disaster scenarios can contribute toward improving patient outcomes.
SPINAL INJURY
2. SPINAL INJURY

2.1 OVERVIEW:

Prognosis for those with trauma to the spine is dependent on the severity of injury to the spinal cord that runs within the bony framework. The priority of approach is to prevent further injury to the spinal cord and complications from neurologic injury. This has implications for all levels of intervention: from extrication to transport to patient care at hospital level. In the event of a large-scale urban disaster, access to specialty care, diagnostic facilities (including adequate X-ray), and intensive, skilled nursing care are likely to be in short supply.

2.2 PRINCIPLES OF CARE:

A. **Identify other injuries**—ensure no other trauma injury due to diminished physical signs and symptoms in the setting of spinal cord injury

B. **Prevent further injury to spine or spinal cord**—safe transfer and movement

C. **Provide stabilization**—typically with bed rest and cervical collar

D. **Prevent complications of neurologic deficit**—respiratory, skin, bowel, bladder care

E. **Provide physiotherapy**—to prevent contracture, pressure ulcers and maintain strength of functioning muscles

F. **Identify**—the rare, special cases that may require further expertise—unstable cervical fracture with normal or near-normal neurologic function (for consideration of skeletal traction)

G. **Care with Transport**—Transport and movement of the patient, whether from accident scene, within the facility, or between facilities, presents the greatest danger for increasing the severity of neurologic damage. At all times, transport with
trained personnel (or at least with people who have had adequate instructions) to provide for spinal precautions using correct equipment and techniques of head and neck support, body support, and appropriate hard-board and equipment (cervical collar—when available, or rolled blankets and sand bags).

* **AVOID:** * Carrying by hand, over shoulder, in Doko, etc.!

**H. Appropriate counseling**, consent and multi-disciplinary approach with attention toward rehabilitation, psycho-social support, and cultural re-integration for each patient whenever possible.

## 2.3 Spinal Injury- Principles of Management

### 2.3.1 Diagnostic Considerations:

Determining whether a fracture is stable (spinal cord protected at time of injury and with subsequent movement) or unstable would be ideal, but unlikely during the scenario of a large-scale disaster—when adequate diagnostic and specialty resources are scarce. Often spinal injuries are missed because the patient is not alert or is suffering from severe, distracting injuries. (NOTE: 1/3 of spinal injuries are associated with concurrent head or abdominal injury). A systematic effort must be made to identify spinal injury using history and careful physical exam. **ALL spinal injuries should be considered unstable until they are able to be adequately evaluated with appropriate tests and clinical specialists.**

Diagnostic points to consider include:

1. Neurologic deficit (may be complete or partial)—should assume an unstable injury
2. Evidence of injury/deformity over spine (bruising, skin lesion or edema—soft, “doughy” feeling over spinous process with/without a palpable “gap” or deformity—indicates unstable injury).

NOTE: DO NOT TEST MOVEMENT OF SPINE if injury is suspected!

3. Severe pain over the spine with/without radiation

4. X-ray examination—May be difficult to obtain good quality and have access to expert interpretation in disaster scenario. They may be indicated if specialist input is available, and can be performed in safe manner (see Annex 1).

5. Cervical spine injury can be ruled out clinically if the patient fulfills (ALL OF) the following (NEXUS) criteria:
   - There is no posterior midline cervical tenderness
   - There is no evidence of intoxication/altered mental status
   - The patient is alert and oriented to person, place, time, and event
   - There is no focal neurological deficit
   - There are no painful distracting injuries (e.g., long bone fracture, multiple trauma, etc.)

2.3.2 MANAGEMENT:

Skilled nursing and physiotherapy care is key to outcome

A. ACUTE CARE—Prevent further injury—SPINAL PRECAUTIONS!
   a) A-B-C-D-E; secondary exam with removal of clothes and exam of back—USING SPINAL PRECAUTION/Log Roll (see below)
b) Cervical collar until cleared clinically or (if available) X-ray

c) Treat hypotension—transection of cord disrupts sympathetic pathways and may cause hypotension—may take several days to resolve. IV infusion with RL or NS—requirements may be high. Monitor respiratory and cardiac status.

**NOTE:** Ensure hypotension not caused by missed injury (chest, abdomen, extremity)

d) Treat ileus—NPO until bowel sounds and gas. Consider NG tube for quadriplegia patients.

e) Catheterize bladder and begin bladder care

f) Steroids generally NOT indicated

**B. PREVENT FURTHER INJURY**

a) All patient movement must be performed in a controlled manner using “spinal precautions”:

- Minimum of 3 people involved (4 is better)
  - Most experienced person controls the head and neck
  - “Log roll” supporting the entire body

b) Apply cervical collar for suspected cervical fracture

- Hard collar (prefabricated) is best
- Soft collar or “blanket roll” with sand bag support if hard collar not available
- Construction of hard collar using foam and POP if expertise exists
- Plaster Cuivasse or Minerva cast— ONLY if expert specialty assistance is available for a documented injury—done after acute phase

c) Appropriate bed/position
- Board covered with two 10 cm foam mattress is best
- Foam pad/pillow between knees and supporting back and pressure points as needed
  - Keep underlying sheet clean, dry, free of creases and food particles

d) Monitor for Autonomic Dysreflexia (patients with injury T6 or above)—excessive autonomic response to stimuli below the level of injury which can lead to LIFE THREATENING CONDITION marked by:
  - Severe Hypertension (BP>200/100); pounding headache; sweating/shivering; chest tightness; feelings of anxiety; blurred vision; nasal congestion; blotch skin rash above spinal injury level; cold "goosebumps" below injury level
  - Treatment: FIRST, Check for possible source of noxious stimuli
    - Bladder distension—make sure catheter not blocked or bladder is empty
      - Check for Urinary Tract Infection
    - Fecal impaction—GENTLE rectal exam and dis-impaction if needed
    - Lower extremity traumatic stimuli
• Treat hypertension as needed
  o Nifedipine 10 mg PO/SL – add other agents if needed
    ▪ May repeat dose in 30 minutes if symptoms persist

C. PREVENT COMPLICATIONS OF NEUROLOGIC INJURY:

GOAL= No Bedsores, No Contractures, No Urinary Tract Infections

a) Respiratory

  ➢ Prevent atelectasis/pneumonia—cough and deep breath
  ➢ Check baseline oxygen saturation, and monitor regular intervals—if available
  ➢ Monitor for DVT/pulmonary embolism—check baseline calf circumference and monitor daily

b) Skin—prevent pressure sore
Turning—using 3-4 member team, “log roll” EVERY TWO HOURS—DAY AND NIGHT. (Over time, family members may be taught how to help with this). Record turning of patient in chart, if possible.

- Turn in sequence every 2 hours—BEGIN IMMEDIATELY: full left lateral—supine—full right lateral—supine—partial left lateral—supine—partial right lateral—supine…repeat
- After 3 weeks, patient may be able to gently assist with turning—if assistive devices (Balkan Beam, etc.) available

Examination daily for evidence of pressure necrosis: sacrum, iliac crests, hips, sides of knees, heels, malleoli, penis (if using condom catheter)

- Redness
- Blister…ulcer
  - In case of skin damage, avoid pressure to area. Place padding AROUND the area of concern (not directly on the area)

Monitor nutritional status and supplement if able

c) Bladder—avoid bladder distension and reflux—monitor fluid intake and output when possible

- Begin intermittent bladder catheterization if possible (lack of staff and supplies may prevent this optimal approach)
  - Every 3-4 hours for first 3 weeks, then every 6-8 hours
- Foley catheter (less optimal)—clamp Foley and release every 2 hours—until patient can progress to intermittent or condom catheter.
d) Bowel—be alert for fecal impaction

- Enema or dis-impaction every 4 days for first 2 weeks
- High residue diet
- Laxative daily as needed
- Begin paraffin suppository and rectal stimulation daily beginning day 4

e) Joint—prevent contracture; preserve strength

- Begin range of motion exercise of joints immediately and do often
  - Special attention to avoid hip, knee, heel cord contraction
- Active strength exercise (upper extremity for paraplegic) with weights or books

D. FRACTURE/DISLOCATION MANAGEMENT

In all likelihood, in a large-scale disaster scenario, access to specialty diagnostic, clinical and nursing resources will not be available. Generally, surgical decompression or acute spinal fusion/fixation should not be considered during the early stages of the disaster event.

a) Spinal decompression—likely not helpful, and access to essential diagnostic and clinical resources not available

b) Spinal fusion—may be helpful in the mid-long-term, but not needed acutely, as long as spinal precautions in place

c) Cervical traction—may be helpful for the (rare) patient with unstable fracture/dislocation cervical injury, and minimal or no neurologic involvement.

Factors to consider:
Requires expert and focused nursing care
Requires portable X-ray capacity
May require (unsafe) transfer of the patient over disrupted roads and with shortage of skilled staff
Generally, these patients will be better served with hard collar, bed rest, and spinal precautions for first 6 weeks—followed by Cervical Brace

E. REFERRAL

a) Must balance risk of transport versus gain of treatment option

b) Most patients are best treated with conservative therapy and good nursing care at local institution

c) Eventual transfer to Spinal Cord Unit for long-term management and Activities of Daily Living when referral mechanisms and capacity are clear

2.3.3 PATIENT INSTRUCTIONS:

- Moral supports for the patient are of utmost importance—treat them and their families with encouragement and respect. Monitor and address mood—check and treat for depression if needed
- Support early teaching of activities of daily living and education of health maintenance to patient and family

2.4 REFERENCES:

1. Primary Surgical Care—Volume 2, Trauma (Maurice King, editor)
2. Surgical Care at the District Hospital (WHO guide)
3. Disaster Management Guidelines—Emergency Surgical Care and Disaster Situations (WHO Guide)
5. Chronic Spinal Cord Injury: Management of Patients in Acute Hospital Settings (Gall, A; Turner-Stotes, L; Clinical Medicine, Vol.8; 2008)

**ANNEX 1:** Spinal X-ray—Evaluation

NOTE: normal X-ray does not mean normal spine! Indications of unstable injury include, BUT ARE NOT LIMITED TO:

- Injury (or mal-alignment) of 2 or more of the 3 spinal columns
- Rotational mal-alignment
- Subluxation or dislocation of one vertebra on another
- Fracture of odontoid
- 50% or more vertebral body compression
- Increased width between the pedicles on the AP view
3. **AMPUTATION FOR TRAUMA**

3.1 **OVERVIEW:**

Patients may require amputation of limb following earthquake due to partial or complete traumatic amputation from the event, or because of severe crush injury. Wounds will likely be severely contaminated or demonstrate frank infection. Particularly with regard to crush injury, there may be different severity of tissue damage at different levels—depending on mechanism of injury, and type of tissue involved (different tissue type—skin, fat, muscle, nerve, bone--has different susceptibility to crush injury). Compartment syndrome must be considered and evaluated in all cases.

3.2 **APPROACH/PRIORITY:**

1. Determine extent of injury and need for amputation, including severity of injury to nerve, vessel, bone, muscle, skin. During surgery examine for tissue color, bleeding, and muscle contraction.

2. Endeavour to avoid amputation if fracture or bone loss is treatable and soft tissue can be rendered clean, vascularized, and sensate.

3. Indication for Amputation
   
   i. *In order to save the life of the patient*

   ii. *Clear evidence of nonviable (“dead”) extremity—no pulse, no bleeding, no sensation. Consult experienced surgeon if in any doubt.*

4. In case of needed amputation, consider the following principles (given likelihood of late treatment, severely contaminated or infected tissue, and questions of viability):
i. Thorough wound toilet including adequate debridement of ALL non-viable and severely contaminated tissue and foreign body followed by irrigation and rinsing of bone and soft tissue.

ii. Plan for Delayed Primary Closure (leave adequate soft tissue envelope for coverage), avoiding unnecessary dressing changes.

iii. Leave stump that is acceptable for fitting prosthesis.

iv. Adequate antibiotic, tetanus, and analgesia coverage.

v. Early mobilization and physiotherapy.

5. Appropriate pre-operative counseling, consent, and multi-disciplinary approach are goals for each patient whenever possible.

3.3 TRAUMATIC AMPUTATION—Principles of Management

3.3.1 DIAGNOSTIC CONSIDERATIONS:
The goal is to preserve extremity function for those that are amenable to repair while at the same time seek to minimize surgical interventions (and drain on limited resources) during the disaster scenario.

1) Recognize patients who can have limb salvage rather than amputation by considering those with adequate bone that can be repaired along with viable soft tissue coverage. Seek senior-level advice if available. Evaluate for (NISSA criteria):

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a. Distal vascularity-sensibility-motor function (vascular and neurologic status)
b. Bone injury/loss
c. Soft tissue injury
d. Obtain X-ray only if the result will change the treatment plan

2) For those requiring amputation--do it in a manner that minimizes surgical interventions and dressing changes—strive for Adequate Debridement and fashioning of skin and muscle flaps/coverage, followed by Delayed Primary Closure of stump of adequate length.

3.3.2 MANAGEMENT

A. OUTPATIENT/ACCIDENT WARD

- A-B-C-D-E along with resuscitation, then secondary survey
- Hydration or Fluid Resuscitation—Start IV infusion (RL or NS)
  - Hydrate patient as needed
  - Treat for shock if needed: 2 large bore IV lines, monitor vital signs, urine output
- Start appropriate, available antibiotic regimen
- Provide analgesia for pain
- Tetanus prophylaxis
- Apply bandage to injury (cover only the wound, not whole extremity)
  - Wash patient and prepare for OT—when stable
B. OPERATING THEATRE — Patients Requiring Amputation

I. General Principles:
Resect dead, severely damaged and contaminated soft tissue and then plan bone resection as distal as possible that will allow for adequate soft tissue coverage at time of Delayed Primary Closure (DPC). This is achieved by:

- Raising healthy skin/fascia layer—as determined by the pattern of the injury
- Develop muscle layer for stump coverage--use intact muscle bundle when possible, to avoid transection of muscle and subsequent more severe edema
- Section of bone proximal to muscle such that soft tissues can be easily approximated at the end of primary operation in order to avoid need for further bone shortening at time of DPC

II. Operative Approach

- Definitive Amputation for Delayed Primary Closure (Recommended Approach): In cases where expertise exists, definitive amputation which includes debridement of contaminated and non-viable tissue, leaving the wound open for Delayed Primary Closure to achieve soft tissue coverage (muscle and skin) of the stump. (see below)

- Guillotine Amputation: may be preferable for the untrained operator outside a formal surgical environment, while recognizing:
  - Dead muscle may be missed because of compartmental nature and uneven distribution of tissue necrosis
• Transection of thick muscle layer (calf or thigh) may have extreme swelling preventing closure without use of skin graft or significant shortening at time of revision
• Subsequent revision often requires further blood loss and shortening—resulting in amputation level that is higher than necessary.

• Compromise approach: to perform the amputation as distal as possible, through viable tissue (and with techniques similar to normal or elective surgery, leaving the stump open. This technique may require revision/shortening of the stump at time of Delayed Primary Closure if soft tissue edema prevents tension free coverage.

III. Operative Technique

Definitive amputation for Delayed Primary Closure

• Apply (pneumatic—if available) tourniquet; Wash and scrub Wound with clean water and soap, Prep and Drape

• Create skin and muscle layers/flaps
  o Try and provide for muscle layer that includes entire muscle belly (in order to decrease edema) rather than transected muscle belly
    ▪ Gastrocnemius muscle (or Soleus muscle for long stump) for BKA
    ▪ Vastus Medialis (medial muscle compartment) for AKA
  o REMEMBER: Post-operative edema of skin and muscle will lead to shortening of soft tissues at time of DPC—keep soft tissue layers/flaps long (at least 8-10 cm longer than length needed for soft tissue approximation at time of DBR surgery) to allow for muscle and skin edema at time of DPC
- Transect bone—Do not strip periosteum proximal to level of bone transection. Shape and smooth bone end as needed
  - BKA—Try to preserve at least 10-15 cm distal to tibial tuberosity (minimum for prosthesis is 4 cm)
    - Transect fibula 3-4 cm proximal to level of tibia transection
  - AKA—10 cm above femoral condyles
  - Upper extremity—keep stump as long as possible that allows for adequate soft tissue coverage

- Division of nerve and vessels
  - Double ligate arteries 1 cm proximal to stump site
  - Gentle traction and sharp division of nerves (to allow them to retract well above stump site)

Note: sciatic nerve should be ligated because of large vessels that run within it

- Irrigate profusely (2-3 liter of saline or available solution of choice)
- Deflate/remove tourniquet and examine for tissue viability. Obtain hemostasis. Minimize use of cautery. Do not use bone wax.
- Apply dressing
  - One layer of gauze over exposed soft tissue
  - 10 cm thick layer of “fluffy gauze” place over exposed wound (CAUTION—do not pack wound—need to allow for drainage)
  - Loosely applied crepe bandage in “Figure of 8” pattern.
C. WARD  

a) Post-operative Ward  
- Post-operative: standard post-op vital signs per standard

b) General Ward  
- Monitor vital signs per standard  
- Check Hb if needed  
- Continue antibiotics and analgesia  
- Chest physiotherapy  
- Wound is left untouched until Delayed Primary Closure at 4-5 days  
  - In case of oozing—overdress wound  
    - If suspect significant active bleeding—consult surgeon  
  - In case of sign of infection (high fever, increasing pain, proximal swelling/redness)—inform surgeon who will determine if patient needs to return to OT for inspection and dressing change

- Consider high protein diet, vitamins, iron—as available

- Assist with turning and check for pressure sores  
  - Treat areas of concern with extra padding AROUND the area of concern.  
  - Foam pad or exam glove filled with water may be used for padding

- Stump elevation for 48 hours (traction frame or bed blocks): patient may sit-- with stump above hip level if appropriate chair available  
  - Physiotherapy
- BKA—gentle knee extension with isometric contraction of quadriceps—do not disturb dressing or strain stump. Gentle hip extension.
- AKA—gentle hip extension—do not disturb dressing or strain stump

**Position to recommend** (for BKA amputation)

* Lying on the back with the knee in complete extension

* Sitting with the knee in extension

**Position to recommend** (for AKA amputation)

* Lying on the belly with a pillow under the thigh

**Position to prevent!** *(Never use pillows under the thigh for AK or Under the knee for BK)*

c) **OPERATING THEATRE—DPC**

- Delayed Primary Closure (DPC) day 4-5
  - Ensure all tissue are clean and viable—if not, need to repeat debridement (above), and begin process again
  - Closure of myoplastic flap over bone stump using absorbable suture
Closure of skin/fascia layer—interrupted, “everting” suture line

Use drain ONLY in case of dead space

d) WARD

I. Post-operative Ward

- Monitor vital signs per post-operative standard

II. General Ward

- Continue to monitor vital signs per standard
- First Dressing after 3 days
- Stump elevation until first dressing, then increasingly mobilize
- Second dressing after 3 more days, then as needed
- Removal of suture 14-20 days
- Physiotherapy
  - Assist with turning and monitor for pressure sores
  - Continue Range of Motion of knee and hip
  - Positioning to prevent contracture; Range of Motion and strengthening exercises
  - Begin stump shaping after second dressing change—elastic bandage
  - Increasingly mobilize patient—vigorous exercise of limb after one week
  - Crutch walking as soon as possible
- Evaluate(typically) for prosthesis 12-15 weeks after DPC
  - Consider early evaluation for prosthesis or temporary prosthesis if personnel, expertise and needed materials are available
3.3.3 PATIENT INSTRUCTIONS

- Encourage active participation in care and physiotherapy
- Strive for early mobilization with crutches
- Introduce to others with amputation in order to set expectations and support psycho-social recovery and cultural re-integration
- Support physical, mental and social rehabilitation

3.4 REFERENCES:

1. Primary Surgical Care—Volume 2, Trauma (Maurice King, editor; 2005)
2. Surgical Care at the District Hospital (WHO guide)
3. Disaster Management Guidelines—Emergency Surgical Care and Disaster Situations (WHO Guide; 2005)
5. The Rehabilitation of People with Amputation (WHO, 2004)
OPEN FRACTURE
4. OPEN FRACTURE

4.1 OVERVIEW:
Open fractures represent complex wounds involving soft tissue and bone. In the setting of a disaster scenario, the majority of patients with open fractures will be presenting late, with severely contaminated wounds, and often times, other injuries. Avoiding complication of the open fracture takes highest priority (sometimes at the expense of rapid mobilization)—especially important to consider in the setting when severe wounds may be treated by the non-specialist surgeon, nurse, or physiotherapist during a disaster scenario.

4.2 TREATMENT PRIORITY:
Priority for treatment of the open fracture depends on meeting standards of basic wound and fracture care revolving around four principles:

- Adequate wound debridement
- Achieving soft tissue cover
- Achieving satisfactory bone healing
- Restoring function for the patient
- Appropriate pre-operative counseling, consent and multi-disciplinary care for each patient whenever possible

4.3 PRINCIPLES OF MANAGEMENT:
Treatment begins with principles of good wound management:

- Emphasize use of liberal wash and scrub with clean water and soap!
- Adequate wound excision/debridement with removal of dead and nonviable tissue, contaminated debris, foreign body
- Adequate wound drainage—most often achieved with bulky, absorbent dressing (and supported with a back-slab in most cases)

- Hemostasis

- Avoid unnecessary dressing changes

- Delayed Primary Closure at 4-5 days (otherwise skin graft/flap as needed)

- Initial fracture stabilization until healing of soft tissue—most often back-slab

- Definitive immobilization/stabilization (most often with POP; traction or external fixation is selected cases) to achieve acceptable configuration and healing of bone

- Tetanus prophylaxis, antibiotic coverage, analgesia

- Adequate/supplemented nutrition

- Nursing and Physiotherapy for early patient mobilization, maintain joint motion, maintain strength, return to optimal function

4.4 OPEN FRACTURES- PRINCIPLES
4.4.1 DIAGNOSTIC CONSIDERATIONS:

Remember that open fractures may be associated with other severe injury—including spinal injury. Examine the patient fully prior to initiating operative therapy.

- Complications (wound infection and osteomyelitis) from open fracture increase the longer the patient goes without adequate wound debridement (optimally performed within 6 hours of injury, although often not possible in the disaster scenario).

- ALWAYS assess distal extremity for vascular (color, pulses), motor, sensory function

- X-ray is often not needed for initial treatment of open fracture, particularly if the wound is large and bone fragments can be visualized during OT. Remember—treat the wound and not the X-ray!
  - X-rays are an aid to precise diagnosis of fracture, but not indispensable for provision of good surgery, wound care and treatment

4.4.2 MANAGEMENT:

A. **Outpatient Department/Accident Ward**

- A-B-C-D-E followed by complete secondary exam with removal of clothing and exam of back (spinal precautions if indicated)

- Hydration or Fluid Resuscitation—Start IV infusion (RL or NS)
  - Hydrate all patients
  - Treat for shock if indicated: 2 large IV lines, careful monitor of vital signs and urine output
• Start appropriate and available antibiotic regimen (4-5 days)

• Provide analgesia for pain

• Tetanus prophylaxis

• Apply bandage to injury (cover only the wound, not whole extremity)—AVOID: tourniquet or circumferential pressure dressing
  o Wash patient and prepare for OT—when stable

B. OPERATING THEATRE (1st)—wound debridement

• Take down dressing and Wash and scrub Wound with clean water and soap—Prep and Drape

• Wound toilet, debridement and irrigation
  o All wounds should go to OT for treatment
  o Debride all severely contaminate tissue, non-viable tissue, foreign body
    ▪ Debride all non-viable tissue—even if it leaves bone exposed—as infected wound will not help fracture healing!
  o Remove free fragments of bone
  o Bone that is firmly attached by periosteum or muscle should remain in place
  o Leave vessel, nerve, tendon intact—but remove contamination or foreign body from them
- Irrigate with 3 liters of NS or available solution using big syringe with cannula (or pulse lavage, if available)

- Apply bulky, absorbent dressing
  - One layer of gauze over exposed soft tissue
  - 10 cm thick layer of “fluffy gauze” place over exposed wound (CAUTION—do not pack wound—need to allow for drainage)
  - Loosely applied crepe bandage.

- Stabilize fracture
  - Back-slab most often achieves adequate stabilization for initial treatment
    - Well-fitted and padded splint as an alternative when lacking resources
  - Consider traction for large wounds or fractures in which distal pulse is lost when traction (hand held) is released (rare)
  - External fixation may be indicated in rare circumstances for vascular injury (viability of extremity is unlikely if prolonged time since insult) or extremely complex and large wounds that will require prolonged therapy to achieve soft tissue closure. Generally there is not a need to apply the External Fixation during initial surgery, and as well, the device and clinical expertise needed to utilize may not be available in early disaster stages.
  - Internal fixation of fractures is discouraged in the disaster scenario characterized by injuries demonstrating severe contamination—often with a “crush component”, delayed wound care, and limited resources and ability to provide a surgical atmosphere that meets AO standards.
I. **Post-operative Ward**
- Standard post-operative vital signs and care
- Check distal extremity for warmth, color, pulses, movement, sensibility

II. **General Ward**
- Continue vital sign check and care per routine
- Continue to check of distal extremity for warmth, color, pulses, movement, sensibility
- Check Hb if needed
- Continue antibiotics and analgesia
- Provide good chest physiotherapy
- Wound is left untouched until Delayed Primary Closure at 4-5 days
  - In case of oozing—overdress wound
    - If suspect vigorous, active bleeding—consult surgeon
  - In case of sign of infection (high fever, increasing pain, proximal swelling/redness)—inform surgeon who will determine if patient needs to return to OT for inspection and dressing change
- Consider high protein diet, vitamins, iron—as available
- Elevation: pillow or bed blocks (foot of bed)
• Assist with frequent turning and monitor for pressure sore (especially in traction patient)
  o Apply padding AROUND the area of concern; using foam or water-filled exam glove

D. OPERATING THEATRE(2nd)—wound closure
• Ensure all tissue are clean and viable—if not, need to repeat debridement (above), and begin process again

• Delayed Primary Closure if wound clean and edges can be approximated.

• Consider skin graft or flap if wound clean, but soft tissue defect too large for DPC
  o Skin graft or flap does NOT need to be done immediately. If further expertise needed to achieve wound closure—consider referral options.

E. WARD
I. Post-operative Ward
• Post-operative vital signs (as above)
• Check distal extremity for warmth, color, pulses, movement, sensibility

II. General Ward
• Continue to check vital signs per routine

• Continue to check distal extremity for warmth, color, pulses, movement, sensibility

• Dressing every 3 days until removal of sutures (10-14 days)

• Close POP when soft tissue has healed
• Continue analgesia

• Assist with frequent turning and monitor for pressure sore (especially in traction patient)

• Physiotherapy: Goal = general mobilization and restoration of limb function
  - Phase I — gentle movement of un-involved joints proximal and distal to immobilized segment
  - Phase II — Mobilize and/or exercise in bed (for patients confined to “bed rest”)
  - Phase III — Retrieval of limb function
    - Begin in earnest when wound healed and bone adequately stabilized

4.4.3 REFERRAL

• Most patients can be treated with adequate wound debridement, soft tissue closure, and bony stabilization with POP (sometimes with window)

• Patients requiring External Fixation because of large and complex soft tissue defect may need referral. NOTE: External Fixation is treatment strategy for obtaining soft tissue closure. Once this has been achieved, most patients should have removal of Fixator and POP applied. Often times pin traction is a more reasonable option for these patients—particularly in a setting in which there is a limitation of resources and technical expertise.
  - Trans-tibial pin traction for open (or closed) femur fracture
- Pin (no. 5) or K-wire (max. 2.5mm) place below apophysis—approximately 10% body weight of traction applied. Elevate foot of bed on blocks.
  - Begin early quadriceps motion IF skilled physio available ("Perkins traction")
- Gallows traction (infants)
- Skin Traction (children—maximum 3kg traction applied)

- Internal Fixation is generally NOT indicated in setting of large-scale disaster and the associated factors present for most injuries.

4.4.4 PATIENT INSTRUCTIONS
- Patient should be encouraged to be active participant in rehabilitation
- Patient should be supported emotionally during the difficult time

4.5 REFERENCES:
1. Primary Surgical Care—Volume 2, Trauma (Maurice King, editor)
2. Surgical Care at the District Hospital (WHO guide)
3. Disaster Management Guidelines—Emergency Surgical Care and Disaster Situations (WHO Guide)