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Flowchart for management of Cervical Spine Trauma and non surgical management

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Goals of management of cervical fracture.

- Restoration of spinal alignment
- Restoration of spinal stability
- Preservation or improvement of neurological function.
- Avoidance of collateral damage.
- Restoration of spinal function
- Resolution of pain
Evaluation

Polytraumatic evaluation (ATLS).

The main principles of cervical evaluation are:

- Assessing and classifying the skeletal injury
- Assessing and classifying the neurological injury
- Assessing associated spinal injuries
- Identifying associated non-spinal injuries
- Establishing treatment priorities during the assessment phase.
Methodological approach to the cervical spine injuries

- Spinal trauma ranges from trivial injuries requiring no interventive treatment, through to major complex, spinal cord and life threatening spinal column injuries.
- Cervical spine injury patients are divided based on the neurological involvement: patients with spinal cord injury and patients neurologically intact.
- On the other hand, patients should be also classified in stable and unstable.
- Patients with SCI will be considered as unstable in any case, and require surgical management.

Basic principles of management for cervical spine trauma

J. K. O’Dowd
Methodological approach to the cervical spine injuries

Actions:
- Proper classification of the injury type
- Assessment of stability of the affected segment.
- Displacement of the cervical fracture.
- Likelihood of reduction.
- Compression of spinal cord.
- Lesion of spinal cord.

Tools:
- Complete neurological evaluation.
- Standard / dynamic X-ray
- CT-Scan.
- MRI
Flowchart for management of Cervical Spine Trauma

- **Lesions non involving the spinal cord**
  - **Stable**
    - **No significant displacement**
      - **Reduction**
        - **Immobilization**
          - **Stable**
    - **Significant displacement**
      - **Reduction attempt**
        - **Reduction**
          - **Immobilization**
          - **Dynamic flexion-extension X-Rays (Follow-up)**
            - **Stable**
            - **Unstable**
        - **Not reduced**
          - **Surgery**
          - **Unstable**
  - **Unstable**
Flowchart for management of Cervical Spine Trauma

Lesions involving the spinal cord

Cardiorespiratory evaluation (ATLS)

Significant Displacement

Halo Traction

Non Reduction

Surgery

Nursing

No Significant Displacement

Immobilization (Halo Jacket)

Reduction

CT scan / MRI

Compression

No compression
AOSpine subaxial cervical spine injury classification

The classification describes injury patterns based on the following four criteria: injury morphology, facet injury, neurological status, and the presence of specific modifiers.
Non surgical treatment of cervical fractures.

- Pharmacological treatment: Painkillers, NSAID’s, Antithrombotic, Ulcus prevention, Antibiotics
- Closed Reduction in case of displaced fractures / dislocations.
- Immobilization.
- Rehabilitation.
Non surgical management: immobilization

- In the initial stage, as a temporally treatment.
- Later on as an adjunct to surgery.
- As the definitive treatment.

- **Cervical brace** (four categories)
  - **Soft collars**: provides minimal motion restriction.
  - **Rigid collars**: Philadelphia, Aspen, Miami, etc
  - **Poster braces** (connection to the torso by two or four metal struts) and cervicothoracic orthoses: SOMI
  - **Minerva cervical brace**.
- **Cast**: uncomfortable for the patient.
- **Traction**.
- **Halo immobilization** (cast, jacket or pelvic).

Rigid collar: Philadelphia collar

- The Philadelphia collar is a two-piece semirigid orthosis made of Platazote, reinforced with anterior and posterior plastic struts.
- The **Philadelphia collar** has been shown to control neck motion, especially in the flexion/extension.
- Restriction in flexion/extension is 71%, lateral bending 34%, and axial rotation 56% (1).
- Disadvantages of the Philadelphia collar are the lack of control for flexion/extension control in the upper cervical region and lateral bending and axial rotation.
- Further, the Philadelphia collar was shown to elicit increased occipital pressure, which may result in scalp ulcers, particularly in elderly or comatose patients.
- **Indications:** can be used to treat stable cervical fractures, or in the postoperative period. In the absence of both neurological abnormality and compression to neural structures observed in CT/MRI, treatment with the Philadelphia collar alone is safe, cost-effective and easily applicable for many cases of upper **cervical** injury (2).

Cervicothoracic orthoses: Sternal-Occipital-Mandibular-Immobilizer (SOMI)

- By incorporating the upper torso into the construct, these braces limit the amount of pivoting compared with a conventional collar
- Adjustability to immobilizes head in prescribed position
- Dorsal section allows patient to lie flat
- Chin support is easily removed as needed (for eating, i.e.)
- Ease of fitting in supine position ensures minimal disturbance.
- Cervical flexion is limited by 93%, Lateral bending is limited by 66% and Rotation is limited by 66%
- Extension is limited only 42%: The SOMI controls extension less effectively than do other orthoses.
- Compared with cervical collars, a cervicothoracic orthosis provides better restriction of motion of the mid and low-cervical spine (C5-C7).

- **Indications**: can be indicated in relatively stable injuries to the lower cervical spine or in the treatment of cervicothoracic injuries, or postoperatively in patients with a questionable fixation.
Minerva cervical brace

- A Minerva cervical brace is a cervicothoracic orthosis with mandibular, occipital, and forehead contact points.
- Modern adaptations of the Minerva exist, incorporating a plastic vest with liner to a mandibular support and an extension to the posterior aspect of the head.
- Radiological evaluation showed the Minerva cervical brace to limit flexion/extension in 79%, lateral bending in 51%, and axial rotation in 88% of cases.
- This brace provides adequate immobilization between C1 and C7, with less rigid immobilization of the occipital-C1 junction.
- The addition of the forehead strap and occipital flare assists in immobilizing C1–C2.
- It restricts up to 75% of flexion–extension at C1–C2.

Minerva cervical brace

• We prefer a customized Minerva cast made of a Scotch cast, which can be individually molded and provides a reliable fixation which the patient cannot simply take off.

• The use of thermoplastic materials and custom-made braces further enhances comfort, compliance and will thus better meet the ultimate goal of brace treatment.

• **Indications:** Is the orthosis of choice when rigid immobilization is required of an unstable cervical spine injury. Stable fractures in C1-C2 segment.

Cervical braces

- Cervical collars were more comfortable than the cervicothoracic orthoses.
- All cervical braces significantly reduced overall sagittal plane flexion/extension motion of the head, as well as axial rotation and coronal plane side-to-side bending (P<0.0001).
- In general, CT orthosis reduces motion more than C orthoses.
Cervical braces

The comparison of efficiency of various cervical orthoses

<table>
<thead>
<tr>
<th>Reference</th>
<th>Method</th>
<th>Results</th>
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<td>Five cervical collars were used for this study. Motion analysis system was used to capture motion relative to the C3-C6 vertebral bodies. The range of motion at flexion-extension, lateral bending, and rotation was evaluated. The following three conditions were evaluated:</td>
<td>Although using a cervical collar is better than no immobilization, collars did not effectively reduce motion in an unstable cervical spine. A cervical collar was used in the study.</td>
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<td>The halo vest orthosis was compared with soft collar, Minerva brace, and Maimi J. collar. The control effects for the segments of C1-2, C2-3, and C3-4 were measured for all devices for fractures of Type II odontoid process.</td>
<td>The Minerva orthosis was as effective as the halo in controlling the cervical motions, especially in the lower part of the cervical spine.</td>
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<td>Twenty normal subjects participated in this study. The efficiency of some cervical collars (Philadephia, Aspen, Soffnek, Maimi J. and NeoLac) in controlling the motion at flexion-extension, lateral bending, and rotation was evaluated.</td>
<td>The results of the reviews done on efficiency of cervical orthoses in treatment of cervical fractures.</td>
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<td>Two orthoses (Aspen, Maimi J. collar) and 2 CTOs (Aspen 2 post, Aspen 4 post) were tested on 20 normal subjects. An apneoelectronic motion measuring system was used.</td>
<td>The results of the comparisons showed that the halo vest orthosis was as effective as the halo in controlling the cervical motions, especially in the lower part of the cervical spine.</td>
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- Based on the studies mentioned above, it can be concluded that the use of the cervical orthosis is a good and effective alternative to surgery to stabilize the injured spine. The Minerva orthosis was as effective as the halo in controlling the cervical motions, especially in the lower part of the cervical spine.
Traction (Gardner-Wells tongs or halo)

TECHNIQUE.

- The Gardner-Wells tongs can be applied using local anesthesia.
- Trendelenburg position with shoulder straps attached to the footend of the table.
- The device should be tightened until 1 mm of the spring-loaded stylet protrudes, which corresponds to an average of 13.5 kg of compressive force.
- The average force necessary to penetrate the inner table with cadaveric specimens with the tong pin was 73 kg, indicating a large safety margin.
- Contraindicated in atlanto-occipital dislocation or complete discoligamentous injuries because of the inherent risk of rapid neurological deterioration, which can be irreversible.
- The initial weight should not exceed 5–7 kg (depending on body weight) and increases incrementally (30–60 min) only after control imaging.
- After tongs application, new radiographs are mandatory.
- If reduction cannot be obtained, or in cases of increasing neurologic deficit, urgent surgical intervention is necessary.

Traction (Gardner-Wells tongs or halo)

**Indications**

- As a temporally treatment is mainly indicated in cases of facet subluxation or dislocation, and in burst-type fractures, to stabilize and realign the cervical spine.
- Early application and attempt at reduction is advocated in patients with a spinal cord injury.
- Controversy mainly exists in those cases of a neurologically intact or cognitively impaired patient, recent literature supporting the safety of early reduction before magnetic resonance imaging (MRI) investigation.
- When the patient is awake, closed reduction with skull tongs is a safe procedure, and MRI is not mandatory in this situation.
- However, if the patient has to undergo general anesthesia for a closed or open reduction, then MRI scan is absolutely indicated.
- Long-term skull traction has a poor tolerance for the patient and is associated with morbidity, it can be part of a treatment plan prior a fusion or prior the instauration of halovest in complex fractures. Conversion to a halo vest after a 1-2-weeks period should be considered.
Halo

- **Frank Bloom (1943)**
  - Apparatus for stabilization of facial fractures
  - “Maxillofacial surgeon”
  - World War II: treated pilots with inwardly displaced facial fractures
- **Nickel (1968)**
  - Similar design
  - Incomplete ring with 3 pin tiara
  - originally developed to immobilize the unstable cervical spine for surgical arthrodesis in patients with poliomyelitis.


Halo: Pin Placement

- The optimal position for anterior halo pin placement is 1 cm superior to the orbital rim (eyebrow), above the lateral two-thirds of the orbit, and below the greatest circumference of the skull. This area can be considered as a relatively "safe zone"
- Ring or crown size is determined by selection of a ring that provides 1–2 cm clearance around every aspect of the head perimeter.
Halo

- The pins should be tightened sequentially in an opposite way, with increments of two in./lb, to a final torque of eight in./lb.
- The pins should be retightened once to eight in./lb 24–48 h later.
- Vest size is determined by measurement of chest circumference with a tape measure.

Halo

- A halo vest is the most effective way to immobilise the cervical spine externally and is superior to braces.
- Affords control and positioning in cervical flexion, extension, tilt, and rotation as well as longitudinal distraction forces.
- It is the stiffest immobilization, restricting up to 75% of flexion–extension in the upper cervical spine.
- It also provides the best control of rotation and lateral bending.
- The use of halo vest may allow in shortening the hospital stay, and is also a relatively cheap method of treatment.
- When a vest has been applied both the supine and upright X-rays must be performed to detect eventual loss of reduction in standing or sitting position.
Halo

- The halo vest seems to be the first choice for conservative treatment of unstable injuries of the upper cervical spine.
- Management of upper cervical spine fracture with halo fixator is safe and effective.
- Drawbacks:
  - Pin track problems
  - Accurate fitting of the vest
  - Lack of patient compliance lead to clinical failures.
  - Intubation can be difficult.
  - The mean morbidity with therapy in a halo vest is 0%– to 3.7%.

Halo.

Indications:

• A halo vest or jacket can be used as definitive treatment, as an adjunct to surgery, or as treatment for non-contiguous fractures.
• Upper cervical spine (C0-C2): isolated Jefferson fractures, hangman's fractures, odontoid type III and type I fractures, with a low dislocation rate.
• Lower cervical Spine (C3-C7). is mainly indicated in cancellous bony injuries with limited displacement.
• The duration of treatment varies between 6 weeks and 4 months. Overall, its use is limited to the treatment of a minority of cervical fractures.

Contraindications: is relatively contraindicated:

• In patients with severe cachexia
• In patients with severe deformity (ankylosing spondylitis or scoliosis).
• In morbid obese patients
• In the elderly
• In non-compliant or tetraplegic patients.
Halo in Elderly

- Tashijan J. Trauma 2006
  - 78 patients, age > 65yo
  - Type II or III odontoid fractures
  - Increased early morbidity and mortality
    - Compared with treatment using operative fixation or rigid collar
- Van Middendorp JBJS 2009
  - 239 patients
  - All ages in halo
  - No increased risk of pneumonia or death in patients >65 years old


Halo Immobilization: complications

- Loosening (36%)
- Infection (20%)
- Discomfort (18%)
- Dural puncture (1%)
- Abducens nerve palsy
- Supraorbital nerve palsy
- Supratrochlear nerve palsy
- Medical complications

11-92% (30-50%)
- Disfagia 66%

Applying a halo ring and vest requires the availability of a trained team
Conclusions. Take at home message.

- The decision-making in choosing the most appropriate treatment modality for a cervical trauma involves many considerations, including injury type, instability, neurologic status, risk of displacement, patient’s body habitus and eventual deformity, location of the fracture, and compliance.
- The choice of one modality over the other should be made on an individual basis, taking the above-mentioned factors into consideration.
- Conservative treatment still has a role as a temporally treatment or as a definitive treatment in cervical fractures.
- The halo fixator continues to be an important tool for cervical spine fracture management.