Use of Spinal Orthoses in Rehabilitation

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Objectives
- Recognize common classes of orthoses
- Rank orthoses by amount of immobilization produced
- Identify factors to consider when choosing an orthosis

Outline
- General principles and considerations in choosing an orthosis
- Orthoses for cervical spine
- Orthoses for thoracolumbosacral spine
Considerations in Orthosis Selection

- DEGREE OF DESIRED IMMOBILIZATION
  - Consequences of inadequate immobilization?
  - Compliance?

Other Considerations in Selection

- Weight
- Adjustability
- Functional Use
- Comfort
- Cosmesis
- Cost
- Durability
- Material
- Ease of donning/doffing
- Access to trach, PEG, etc.
- Access to surgical sites
- Provision of aeration

Indications for Spinal Orthoses

- Pain relief
- Mechanical unloading
- Scoliosis management
- Spinal immobilization after surgery or traumatic injury
- Compression fracture management
- Kinesthetic reminder to avoid certain movements

Avoid Unnecessarily Restrictive Orthoses

- Functional
  - Chin control for power wheelchair
  - Balance
  - Ability to look down for self cath or ambulation
  - Swallowing

- Somatic
  - Discomfort (usually increases with restriction)
  - Skin breakdown
  - Loss of ROM
Factors Affecting Immobilization

- Fit of orthosis
  - More restriction with close fit (and with straps tightened fully)
- Body habitus
  - Generally more difficult to immobilize obese patients

Cervical Orthoses

Common Uses of Cervical Orthoses

- Unstable spine
  - Promote bony fusion by restricting motion
  - Prevent further neurologic loss
  - Correct deformity and maintain alignment
  - Prevent progressive deformity
- Neck Pain
  - Acute Neck Pain
  - Chronic Neck Pain
  - Traction: modality or orthosis
- Head Support
  - Severe neck weakness

Biomechanics: Cervical Spine

- C-spine is the most mobile spinal segment
  - C1-2 accounts for 50% of rotation in the cervical spine
  - C5-6 has the greatest amount of flexion and extension
- C-spine is difficult to immobilize
  - Large ROM in multiple planes (coupling)
  - Multiple joints
  - Areas where pressure is hard to apply
Types of Orthoses

Classification based on levels immobilized
- Cervical
- Occipital/Mandibular-Cervical-High Thoracic
- O/M-Cervical-Low Thoracic
- Cranial-Cervical-Thoracic

Soft Cervical Collar

- Class: cervical
- Design: foam, stockinette, Velcro
- Immobilization: very minimal

Soft Cervical Collar

Indications
- Kinesthetic reminder to limit movement
- Warmth
- Psychological benefit? (or harm)

O/M-Cervical-High Thoracic

- Philadelphia collar
- Miami-J collar, Aspen collar, etc.
- Primarily limit flexion-extension
- Better upper cervical restriction than some low thoracic braces
Philadelphia Collar

- Plastizote
- Plastic support struts
- Molded mandibular and occipital supports
- Extends to upper thorax
- Anterior hole for trach available

Philadelphia Collar and Pressure Ulcers

- ~1/3 of major trauma patients develop ulcers under collar (usually occipital) after 3 days
- One study shows reduced risk with use of different collar (Aspen)

Philadelphia Collar

- Minimal control of rotation and lateral bending with collar alone
- Philadelphia Stabilizer
  - Lower thoracic extender
  - Aimed at C6-T2 injuries

Miami-J Collar

- Hard plastic
- Cloth pads
- Cutout for trach
- Similar or slightly greater restriction than Philadelphia and Aspen
Aspen Collar

- Similar to Miami-J and Philadelphia
- Slightly better than Philadelphia for rotation and lateral bending

Aspen Vista

- One size fits most adults
- Collar height adjusts with dial

Aspen CTO
O/M-Cervical-Low Thoracic

- 4-Poster Brace
- SOMI
- Minerva Brace

4-Poster Brace

- Anterior and posterior chest pads connected by leather straps
- Molded mandibular and occipital supports
- Less upper C-spine immobilization than others in this class
  - Controls flexion and extension
  - Lateral flexion and rotation not well controlled

SOMI

- Sterno-Occipital Mandibular Immobilizer

- Rigid plastic anterior chest piece connects to occipital plate by uprights
- Removable mandibular piece allows for eating, washing, shaving etc while supine
- No posterior rods; can be donned while supine

SOMI

- Controls flexion better than extension
  - Very effectively controls flexion at AO and C1-3 segments
  - Indicated for AO instability caused by RA
Minerva Brace

- Posterior chest plate; optional headband
- Similar to Yale orthosis
- Other "Minerva" braces are different
  - Minerva body jacket
  - Minerva cast

Halo Vest

- Cranial-cervico-thoracic
- External cranial fixation pins secure rigid halo
- 4 posters attach to anterior/posterior vest
- Maximal ROM restriction
  - Used for unstable fx

Contraindications

- Stable fx when less invasive management could be used
- Concomitant skull fx
- Soft tissue trauma over pin insertion sites
Halo Vest Complications

- Pin-related complications
  - Loosening, infections, scarring
- Vest-related complications
  - Pressure ulcers
- CPR: okay with current designs
  - Read instructions on vest before code

Wire/Bendable Collars

- For patients who will use collar for long-term due to neck muscle weakness
- Adjustable
- Good airflow
- Large open area for tracheostomy
- Example: Headmaster collar
ROM Restriction from Cervical Orthoses

- Order (least→most restrictive) is similar in most studies
- Absolute degrees allowed by each orthosis differs greatly between studies
- Flexion/extension easier to control
- Minimal differences Philly → SOMI
- Halo provides considerably more immobilization in nearly all studies

Orthoses for Acute Neck Pain

Crawford et al, 2004: RCT of whiplash injuries
- Early mobilization with exercise vs. 3 weeks in soft C-collar followed by exercise
- No difference in pain, ROM, ADLs at any follow-up interval
- Those treated with C-collar took significantly longer to return to work after injury

Orthoses for Chronic Neck Pain

- “Not enough scientific testing exists to clearly determine the effectiveness of exercise, traction, acupuncture, heat/cold applications, electrotherapies, cervical orthoses and chronic pain / cognitive behavioural rehabilitation strategies”
  ◦ Cochrane Database of Systemic Reviews

Orthosis Selection and Duration of Use after Fracture or Surgery

- Some studies compare orthosis alone vs. surgery plus orthosis
- Almost none compare different collars or duration of use
- Typical duration: 6 weeks – 3 months
  ◦ NO RCTs of post-op bracing
**Spinal Orthoses for Thoracic, Lumbar, and Sacral Spine**

- Thoracic spine
  - Least mobile spinal segment due to restriction by ribs
  - Primary movement is rotation

- Lumbar spine
  - Primary movement is flexion/extension and lateral flexion
  - Minimal axial rotation due to facet joint orientation

**Common Uses of TLSOs**

- Acute spinal fracture with paraplegia
  - Immobilize 4 – 5 segments above/below fx

- Immobilization after spinal surgery

- Osteoporotic compression fracture

- Spinal deformity
  - Idiopathic or neuromuscular scoliosis
  - Thoracic kyphosis

- Back pain
  - 2001 systematic review found NO evidence that spinal orthoses are effective in prevention or management of LBP

**Biomechanics: Thoracolumbar spine**

- Thoracic spine

- Lumbar spine

**Degree of Immobilization**

- Available orthoses provide varying degree of immobilization (as with cervical spine)

- Fewer studies comparing ROM with TLS orthoses

- Immobilization of upper T-spine can be provided by some of previously described cervical orthoses
  - SOMI, Minerva brace, Halo vest

- Can add cervical extension to a thoracolumbar brace
**Abdominal Binders**
- Minimal restriction of movement when used alone
- Compress abdominal contents to limit spinal movement (flexion)

**Lumbosacral Corsets**
- Plastic or metal stays; uncomfortable if patient moves
- More of a reminder than an immobilizer
- Sometimes used for acute/chronic LBP
- Not appropriate for fracture or post-op use if high degree of immobilization needed

**Thoracolumbar Corsets**
- Similar to lumbosacral corset, usually with stays across mid to lower thoracic spine
- Limits flex/ex and lateral bending
- Uses
  - Stable spine fractures
  - Post-op immobilization
  - Osteoporotic compression fx

**Chairback Brace**
- Lumbosacral orthosis
- Posterior and lateral uprights
- Pelvic and low thoracic bands
- Primarily controls flexion-extension of lumbar spine
  - Reduces lateral flexion by about 50%
Jewett Brace

- Hyperextension-type TLSO
- Controls flexion with 3 point pressure
  - Anterior pad on sternum
  - Posterior pad on thoracolumbar spine
  - Anterior pad on pubic symphisis

- Limits flexion in lower T- and upper L-spine
- No abdominal compression
- Not appropriate for paraplegia
- Often used with stable compression fractures (T10-L2)

Jewett Brace

- Anterior sternal/pubic pads; posterior pad/strap
- Easy to don/doff; difficult to adjust
- Uses:
  - Stable vertebral body fractures
  - Reduce kyphosis in patients with osteoporosis

Cruciform Anterior Spinal Hyperextension (CASH) Brace

- Prefabricated
  - Example: Boston
  - Generally not appropriate for SCI

- Custom fabrication
  - Usually molded plastic and bi-valved
  - Can be modified after fabrication to adjust fit

- Used for T6-L4 fractures

TLSO Body Jackets
TLSO Body Jackets

- Advantages
  - Forces applied over large surface area
  - Able to limit motions in all directions to high degree

- Disadvantages
  - Risk of skin breakdown if poorly fitting
  - May require new orthosis with weight loss
  - Harder to achieve some functional mobility goals (since it restricts movement so well)

Milwaukee Brace

- CTLSO with lateral pads in non-circumferential arrangement
- Used for treating idiopathic scoliosis in conjunction with other treatments
  - Discomfort from brace components causes patient to actively contract spinal muscles and correct spinal curvature
  - Trunk muscles are in constant use, consequently, disuse atrophy does not occur

Milwaukee Brace

- Bracing usually begins with 25° curve
  - Ineffective in adolescents when >45° curve
- Apex of curve T9 or lower ➔ TLSO
- Apex higher than T9 ➔ Milwaukee Brace
- Strong evidence that bracing prevents curve progression

Treatment of Idiopathic Scoliosis
Treatment of Neuromuscular Scoliosis

- Milwaukee brace is a poor choice
  - Patient lacks voluntary motor control to correct spinal deformity and may have spasticity
  - Pressure distribution isn’t as even as with a molded body jacket
- Usually treated with TLSO body jacket

Immobilizing Upper and Lower Ends of TLS Spine

- Upper Thoracic Spine
  - Cervical extension frequently recommended (CTLSO)
- Lower Lumbar Spine
  - TLSOs can increase movement at LS junction
  - To immobilize lowest part of L-spine, one thigh must be immobilized in extension

Cost of Orthoses*

- Soft: $50
- Philly: $125
- Miami J: $150
- Aspen: $160
- SOMI: $480
- Halo: $2800
- Headmaster: $105
- Jewett: $460
- Knight-Taylor: $540
- Milwaukee: $2200
- Custom TLSO: $1500

* (per eMedicine reference)

What is the primary stabilizing effect of the flexible lumbosacral orthosis (AKA abdominal binder)?

1. Restricting spinal extension
2. Preventing atrophy of trunk muscles
3. Elevating intra-abdominal pressure
4. Enhancing kinesthetic feedback
What is the primary advantage of a sterno-occipital-mandibular immobilizer orthosis (SOMI)?

1. The SOMI limits cervical extension exceptionally well.
2. The SOMI is easy to don while the patient is supine.
3. The SOMI offers a high level of patient comfort.
4. The SOMI limits atlantoaxial motion exceptionally well.

Which spinal orthosis is used to prevent thoracic spinal flexion by providing 3-point pressure over the sternum and pubis anteriorly and the upper lumbar spine posteriorly?

1. (a) Custom molded, plastic thoracolumbosacral orthosis
2. (b) Lumbosacral corset with posterior metal stays
3. (c) Jewett orthosis
4. (d) Taylor orthosis

References