

Introduction to Prosthesis & Orthotics



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General Principles of Orthosis

- 1) **Use of forces**: Orthoses utilize forces to limit or assist movements.
 - Rigid material spanning a joint prevents motion (e.g. posterior tube splint).
 - A spring in a joint is stressed by one motion and then recoils to assist the opposite desired motion (e.g. leaf spring orthosis).
- 2) **Sensation**: An orthotic device often covers skin areas and decreases sensory feedback. Proprioception should be preserved where possible.

General Principles of Orthosis

3) Correcting a mobile deformity:

- A flexible deformity may be corrected by an orthosis, like the one given in genu recurvatum or mobile scoliosis.
- The corrective force must be balanced by proximal and distal counter forces (three point force systems).

4) Fixed deformity:

- If a fixed deformity is accommodated by an orthosis, it will prevent the progression of the deformity.

General Principles of Orthosis

- 5) **Adjustability**: Orthotic adjustability is indicated for children to accommodate their growth and for patients with progressive or resolving disorders.
- 6) **Maintenance and cleaning**: The orthosis should be simple to maintain and clean.
- 7) **Application**: The design should be simple for easy donning and doffing. The more complicated the gadget, the less likely it is to be accepted for permanent use.

General Principles of Orthosis

- 8) **Limitation of movement**: Limiting motion to reduce pain (e.g. knee brace).
- 9) **Gravity**: Gravity plays an important role in upper limb orthosis, especially in those joints where the heaviest movement masses are present (e.g. Rolyan shoulder cuff can be used in hemiplegia to prevent subluxation of the shoulder, which is the largest joint prone for the deleterious effects of gravity).

General Principles of Orthosis

- 10) Comfort:** The orthosis should be easy to wear and comfortable to use. This is possible if the forces meant for correction are distributed over the largest area possible.
- 11) Utility:** The orthosis must be useful and serve a real purpose. If one hand is functional and normal, an upper extremity orthosis for the affected side may not be used as most activities of daily living can be performed with the good hand.

General Principles of Orthosis

- 12) **Cosmesis**: Cosmesis is important especially in the hand. A functional but unsightly orthosis is often rejected if the patient values appearance over function.
- 13) **Duration**: Use only as indicated and for as long as necessary.
- 14) **Appropriateness**: It should allow joint movement wherever appropriate.

The Patient-Orthosis Interface

- The **patient-orthosis interface** may be defined as the junction between the body tissues and orthosis. This is the support surface through which forces are transmitted.
- When force is applied through an interface there will be some deformation of both surfaces, depending on their relative thickness, the relative shapes of the underlying rigid structures and the level of the applied force.

The Patient-Orthosis Interface

- This leads to a progressive breakdown of that tissue and, in the case of paraplegia with loss of sensation and the shift reflex; this is the basis for the formation of a pressure sore.

Classification of Orthosis

1) According to Function

- 1) **Supportive**: It stabilizes the joints and supports the body in its anatomical position (e.g. calipers, gaiters).
- 2) **Functional**: It stabilizes the joint and also makes up for a lost function (e.g. foot drop splint in common peroneal nerve palsy or dynamic cock-up splints in wrist drop).
- 3) **Corrective**: To correct deformities (e.g. club foot boot in congenital talipes equinovarus).

Classification of Orthosis

1) According to Function

- 4) **Protective**: To protect a part of the body during its healing (e.g. rigid four post-collar for fracture cervical vertebrae).
- 5) **Prevent substitution of function**: In a full length caliper, substitution of hip flexors by abductors or adductors of hip and other similar trick movements are prevented.
- 6) **Strengthen certain groups of muscles**: Tenodesis splint.

Classification of Orthosis

1) According to Function

- 7) **Relief of pain**: The lumbosacral corset supports the lower back, preventing painful movement.
- 8) **Prevent weight bearing**: A weight relieving orthosis, prescribed for conditions like fracture calcaneum will take weight away from the injured site to a proximal site like the patellar tendon bearing area.

Classification of Orthosis

2) Regional Classification

- They are classified according to the anatomical area fitted with the orthosis.

1) **Spinal Orthosis**

- Cervical Orthosis
- Head-Cervical Orthosis (HCO)
- Head-Cervical-Thoracic Orthosis (HCTO)
- Sacral Orthosis
- Lumbo-sacral Orthosis (LSO)
- Thoraco Lumbo-sacral Orthosis (TLSO)

Classification of Orthosis

2) Regional Classification

2) **Upper Extremity Orthosis**

- Shoulder and Arm Orthosis
- Elbow Orthosis
- Wrist Orthosis
- Hand Orthosis

3) **Lower Extremity Orthosis**

- Foot Orthoses (FO)
- Ankle-Foot Orthoses (AFO)
- Knee-Ankle Foot Orthoses (KAFO)
- Hip-Knee-Ankle-Foot Orthoses (HKAFO)

Contraindications to Orthoses

- 1) Severe deformity which cannot be accommodated in the orthosis.
- 2) If it limits movements at other normal joints.
- 3) Skin infections.
- 4) When the muscle power is inadequate to perform its function because of the weight of the orthoses.
- 5) Where the orthosis interferes grossly with clothing or limits one's style of living.
- 6) Lack of motivation or other psychological problems.
- 7) Very young or old patients.

Disadvantages of Orthosis

- 1) Lack of cosmesis: an unsightly orthosis is often the reason for a patient discontinuing its use.
- 2) Muscles supporting the spine can become weak.
- 3) Wherever segments are immobilized, we find increased movements at ends of these segments.
- 4) The person becomes psychologically dependent on it.
- 5) Reduction in bone density.
- 6) Skin ulcerations or calluses at the patient orthoses interface.

General Objectives Related to Orthotic Fit

1) Safety

- The orthosis should not harm the user.
- An orthosis should not produce any irreversible side effects when worn by the patient over a long term or for an extended period of time.

General Objectives Related to Orthotic Fit

2) Donning and Doffing

- Ideally, the patient should be able to don and doff his/her orthosis independently.
- If a patient requires assistance in donning or doffing, the procedure should be relatively simple for the caregiver.
- The method of securing the closures of the orthosis should be repeatable and consistent to always ensure a satisfactory fit.

General Objectives Related to Orthotic Fit

3) Comfort and Skin Tolerance

- When an orthosis is removed, any noted discoloration to the patient's skin and soft tissue should dissipate after approximately 10 minutes to ensure that undue pressure or shear is not occurring due to wear or use.
- Patients should be able to accommodate and tolerate the use of an orthosis well enough to meet the wear schedule of the treatment plan.

General Objectives Related to Orthotic Fit

3) Comfort and Skin Tolerance

- In orthoses that encompass body segments (i.e., thermoplastic TLSO), heat retention may stress the wearer's thermoregulation capabilities, which may contribute to discomfort and reduced compliance.
- A common preventive measure is for the patient to use an interface barrier such as fabric stockinet, which acts as a wick to increase air flow while providing an additional benefit of reducing shear forces between the orthosis and the skin.

General Objectives Related to Orthotic Fit

3) Comfort and Skin Tolerance

- Normal and excessive perspiration that occurs with the use of an orthosis may increase the risk of skin problems related to harboring microorganisms at the skin surface (bacteria, fungi).
- A more frequent hygiene regimen may be needed to reduce the potential of trauma related to moist skin problems.
- The orthosis should not create any skin and underlying soft tissue irritations.

General Objectives Related to Orthotic Fit

4) Cosmesis

- The appearance of the orthosis should be socially acceptable.
- An orthosis should be as compact as possible and its shape should emulate that of the underlying anatomical shape and contour.
- The orthosis should not be bulky or cumbersome.
- The orthosis should not draw undue visual attention.

General Objectives Related to Orthotic Fit

5) Surface Texture and Finish

- The final finish of the orthosis should be smooth with no rough edges and any anchors of the component parts such as rivets should be flush with the surface, particularly on the side that interfaces with the skin and underlying soft tissue.

General Objectives Related to Orthotic Fit

6) Psychosocial Considerations

- Persons wearing orthoses for improved function and mobility should be encouraged to appreciate those benefits to their general well-being so that any psychosocial issues from using an orthosis may be of less concern by comparison.

General Objectives Related to Function

1) Prescription and Treatment Objectives

- The orthosis should meet the clinical objectives of the prescription.
- Confirmation of treatment outcomes should be validated by clinically relevant tests and measures.
 - **Example:** to confirm that an AFO prescribed for the treatment of weak ankle and foot dorsiflexion provides adequate toe clearance during swing phase and controlled plantar flexion during initial stance phase should be performed by observational gait analysis to assess whether the desired outcome is met.

General Objectives Related to Function

2) Function During Activities of Daily Living

- Activities of daily living (ADL) should be maintained at their current level or should improve with the use of an orthosis, as opposed to interfering with functional activities.
- Confirmation of ADL outcomes should be validated with clinically relevant tests and measures.

