

ORTHOSES , SPLINTS , BRACES AND OTHER ORTHOTIC DEVICES

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Abstract

Orthotics is concerned with the design and fitting of supportive devices to patients who because of muscle weakness or deformity have disabeling conditions of the limb or spine.

Key words: orthoses, splints, braces, serial casting

"L`Orthopedie ou L`art de Prevenir et de Corriger dans les Enfants, le Derformitees du Corps" was the title given by Nicolas Andry to his book written in 1741, and so the notion of orthopaedy was born, based on the greek "orthos" (= strait) and " paideuein / pais"(bring up/child).

Orthopaedic pathology was common since dawn of mankind (tuberculosis of the bones, posttraumatic fractures).

But the conservative treatment was initiated by Hippokrates, the correctiv grips he described are used till ower days. He was using bandages with corrective role as well as shoes that could maintain the position of the foot.

Plaster casts were used for the first time by arab doctors in the X-th century, but europeans started to use them at the end of the XVIII-th century. During the middle ages the anceser of the brace was born :an iron-built armour, but with no corrective rol. Documents about the use of splints to reduce contracture of the knee or elbow appear in Strassburg in 1517. Ambroise Pare used iron plates to correct deformities in scoliosis in the XVI-th century.

Braces , as well as other orthotic devices ,suffered a constant improvement (metal, wood,fabric) during ages. Today they are made of synthetic materials and have an important corrective-functional part.

The concept of bracing was considered to be the shoring up of falling or paralyzed body segments. With the use of thermoplastics this concept has shifted to a more dynamic idea of promoting improved functional efficiency. This new view has led to developments in orthoses that provide minimum stabilization while restoring proper structural and biomechanical alignment. The orthotic devices cover a wide range of products including collars to support the neck, spinal supports, splints, belts, corsets, leg callipers and splint and special footwear.

Goals of intervention with lower extremity orthoses and splints in pediatric population :

-prevention of contractures and deformity for children with cronic neuromotor impairment (protects cartilaginous and soft tissues from deforming effects of weight-bearing strains)

-correction of deformity (casts, splints orthoses are used to stabilize bony structures during growth and to apply corrective forces to the weight-bearing joints over a prolonged period of time.

-provision of optimal joint alignment in order to respond appropriately to direction and degree of force applied by muscle and weight-bearing.

-selective,minimal restriction of motion

-protection of weak antigravity muscles (weakness occurs following surgery or following prolonged disuse of a muscle group, and can lead to overstretch of the muscle tendon and places verry high compensatory demands upon other muscle groups.)

-control of tone and tone- related deviations (structural alignment in the foot promotes an improved balance of muscle power and reduces compensatory excessive muscle tone)

-enhancement of experience (supportive devices provide the nonambulatory child with the experience and physiologic benefits of the standing position without deforming the feet.

-attention to cosmesis and weight.

The role of orthoses and splints is primarily limited to maintenance of achievable alignment and reduction of functional deformity in children.

Lower extremity splints are an alternative to expensive orthoses for small children who grow rapidly while exhibiting changes in foot size and alignment; as a short-term distal support system during rehabilitation (after hamstrings lengthening, tendo-Achilles lengthening); as an evaluation tool in clinical decision making; as interim support to the delivery of an orthoses; as a means of providing a variety of function-specific support systems.

The stabilizing foot splint is used in managing mild to moderat pronation deformity in children with neuromotor impairment(pes planovalgus due to ligament laxity or hypotonia, calcaneus varus deviation).

In cases of equinovalgus deformity(which combines pronation of the foot with limitation of mobility into ankle dorsiflexion) or equinovarus deformity(the combination of equinus with supination of the foot) an ankle- foot splint is indicated when the foot structures can be passively realigned or an ankle-foot orthosis-whether solid or hinged-when the deformity is fixed.

The genu recurvatum related to equinus in children with cerebral palsy is managed with a knee hyperextension splint.

The primary factor to crouch deformity is

weakness in the triceps surae group, so a crouch-control ankle-foot splint could be of help.

Using corrective progressive casts in series is a conservative intervention measure by which casts are applied and removed in succession in order to help regain or increase extensibility in muscle and connective tissue surrounding the casted joint. Casting is undertaken gradually enough to allow the cellular growth changes to occur. The two types of contracture in cerebral palsy are: hypoextensibility related to imbalance of hyperactivity between the agonist and the antagonist muscles and a more passive type of hypoextensibility revealing a dysfunction in trophic or growth regulation (muscle growth does not keep pace with bone growth, so contracture worsens steadily with growth). Tardieu et al. advised using three casts in a three week period to gain extensibility in the triceps surae group. The casts extended from the foot to either below or above the knee (with involvement of the gastrocnemius muscle) and gain of up to 15 degrees of dorsiflexion range were possible with progressive casting.

Disadvantages of serial casting are muscle atrophy; the inconvenience of plaster -heavy; pressure sores; risk of peroneal nerve damage; possible diminish of range of motion gained by casting in six to twelve month depending of follow-up management, growth rate, changes in activity level, illness, family stress. Repetition of the progressive casting might be required every year or two to maintain or regain extensibility. If the casting process fails, surgical correction have to be considered.

The advantage of a serial cast course followed by consistent night splinting may serve to prevent the need for surgical lengthening of muscle tendon.

An other orthotic device applied to the body to limit motion, correct deformity, reduce axial loading or improve function is the brace.

The cervical spine is the most mobile spinal segment with flexion greater than extension, good rotation and bending. The thoracic spine is the least mobile and has a greater flexion than extension. Lateral bending increases in caudal

direction, axial rotation decreases in caudal direction.

The lumbar spine has minimal axial rotation. The greatest movement in the lumbar spine is flexion and extension. Immobilization of the spine increases erector spinae muscle activity since normal rotation that occurs with ambulation is limited by the orthosis.

The biomechanical principles in orthotic design include horizontal forces, fluid compression, distraction, construction of a cage around the patient, placement of an irritant to serve as a kinesthetic reminder and skeletal fixation.

Orthotic devices are named by the body regions that they span :

- cervical orthotics - soft or hard collar (kinesthetic reminder to limit neck movement)
- head cervical orthotics -include chin and occiput and decrease range of motion - the Philadelphia collar
- cervical thoracic orthotics - halo device- treatment of unstable cervico-thoracic fractures
- thoracolumbar orthotics -anterior spinal hyperextension brace, Jewett hyperextension brace (thoracic and lumbar spine fractures)
- thoracolumbosacral orthosis or custom -molded body jacket offers best control in all planes of motion indicated in compression fractures, bracing for idiopathic scoliosis
- lumbosacral orthotics-chairback brace-indications for unloading intervertebral discs, relief low back pain, limits flexion and extension.

The main goal of a brace in scoliosis is to prevent further deformity and prevent or delay surgery (Milwaukee brace -CTLSO, Boston brace- TLSO, Charleston bending brace -maximum side bending correction).

Most adolescents diagnosed with idiopathic scoliosis are prescribed bracing treatment if their curve is between 25-40 degrees, from a point (usually 45 degrees) surgery might be considered. Therefore patients who are braced should have lower rates of surgery than those who are not braced.

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