Bracing development for patients with EOS

Bracing for scoliosis

The history of diagnosing and managing scoliosis goes as far back as the 5th century BC. Treatments with casts and braces have evolved over time, and with increasingly supportive scientific evidence there is renewed enthusiasm and interest in this form of treatment for scoliosis. In this article I will provide an overview of the current use of cast and braces in the management of scoliosis.

Cast bracing – its use in infantile idiopathic scoliosis

Infantile idiopathic scoliosis (IIS) is a form of early onset scoliosis (EOS) that has no underlying cause, with age of onset before 3 years. Early recognition and treatment is crucial since progression of scoliosis in this group of patients may harm lung development. The late Miss Min Mehta, FRCS, who worked at the Royal National Orthopaedic Hospital in Stanmore is largely credited for popularising the use of casting in the management of IIS. Through her early work she was able to identify curves that were likely to improve and those that would progress.

She showed that by applying force to straighten the spine, especially during a time of rapid growth, the spine can be allowed to grow in its corrected position. The Mehta technique of casting is done under general anaesthesia on a specially designed casting table (see figure 1). It involves applying halter traction to the head and a stockinette around the pelvis to provide traction, thus helping to stretch and untwist the spinal curvature. Three to four layers of plaster cast are applied and initially moulded around the hips and body, before manipulation around the rib prominence to help with final correction. During this manipulation, the surgeon de-rotates the spine by placing one hand posteriorly at the apex of the curve and the other hand anteriorly over the rib prominence. A mirror at the base of the table enables the surgeon to accurately position his hands for this correction manoeuvre. During the procedure two additional assistants are required, one to provide counter pressure on the upper chest, and the other to help mould and maintain the cast around the pelvis. Once set, it can be reinforced with fibreglass for added strength (figure 2). Miss. Mehta's famous research described her results from a study of 139 patients with infantile EOS, showing an improvement of smaller curves, especially if treatment was started before 2 years of age.

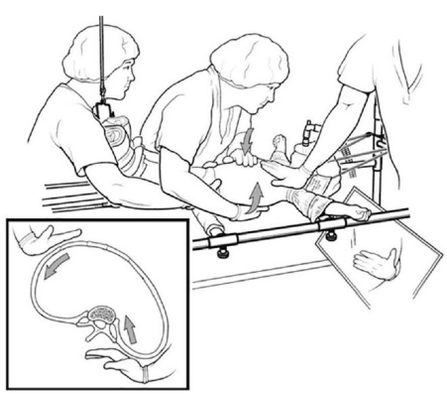

Figure 1. Illustration demonstrating the application of a Mehta cast

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Figure 2. A Mehta cast with windowing anteriorly to allow for comfortable breathing and feeding

Although casting allows for constant pressure to be applied, the casts are not removable and require changing every 2 months for younger children (younger than 2 years), or at intervals of 3-4 months for older children (older than 3 years). The predominant complaint with casting is of skin irritation, but other issues include difficulties in breathing and repetitive general anaesthetics for cast changes. Plaster jackets can also crack, crumble, and ultimately weaken during the later stages of each treatment period. Some patients are afforded a 'cast holiday', a period of time when they are allowed a break from cast treatment, eg, during the summer months.

An alternative in the infantile idiopathic group of patients is to consider the OKM™ brace, a custom made removable rigid brace (figure 3). It has a two-part medical plastic foam interior with cotton outer linings and a zip to enable removal. Initially the correct size of vest is chosen for the patient. The plastic is then mixed with its setting agent for 20 seconds to produce foam, which is then poured into the vest and spread over the whole surface of the vest. The vest is then applied to the patient and zipped in place. The vest can then be moulded by hand to achieve the desired correction. Within a few minutes the plastic sets and a rigid, moulded brace that can be easily removed is created.

Figure 3. OKM™ brace, front and back view

Braces

For older children who are still growing and present with an idiopathic scoliosis, bracing is the only modality available to limit curve progression and the need for surgery. It is important to understand that a brace will help to prevent or slow down progression of a scoliosis curve during periods of growth. Bracing might help in preventing the need for surgery, but will not produce a lasting correc-

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tion of the scoliosis. The natural history of juvenile idiopathic scoliosis (JIS) is more aggressive than adolescent idiopathic scoliosis (AIS), with brace treatment less likely to be successful in avoiding the need for surgery. Most evidence supporting the use of braces is limited to AIS.

Different types of brace

Many different types of braces have been designed and developed for the management of adolescent idiopathic scoliosis. Early designs included the Milwaukee brace, a full body brace extending from the skull to the pelvis, and the Wilmington brace, a custom made thoraco-lumbar sacral orthoses (TLSO). Some braces were developed specially for night time wear, such as the Charleston and Providence.

With increasing evidence linking the success of bracing to time spent wearing the brace, modern braces are considered as 'full-time braces'. Below I will describe two different types of 'full time' braces that are used, the rigid 'Boston' and the flexible 'SpineCor' brace.

Boston Brace

The Boston bracing system is a form of TLSO (figure 4) and is one of the commonly used and studied forms of rigid bracing in adolescent scoliosis. It is usually made from a standard pattern; however, a made to measure Boston brace can be created from a plaster cast mould of a patient. It has a hard plastic outer shell and a softer inner foam lining. An orthoptist will prepare a brace blueprint, thereby creating an individual brace for a specific curve type. Features key to its design include incorporating lumbar and pelvic flexion, allowing for active and passive correction, pad pressure at the apex or below, and a demonstrable area of relief opposite to areas of force and pressure. The brace establishes a firm foundation on the pelvis from which forces can be applied to the spine. Velcro straps and an opening posteriorly allow for easy removal.

Figure 4. Boston brace with an axillary extension to use in curves with a thoracic component.

SpineCor Brace

Developed at the Sainte Justine Hospital in Montreal, Canada, this is a dynamic, non-rigid form of bracing that can be used in juvenile and adolescent scoliosis (figure 5). It is based on the corrective movement principle, allowing for whole body postural re-education on the basis of a theory that scoliosis could be related to unequal spinal growth, as well as postural/neurological abnormality and muscular imbalance.
The SpineCor brace consists of an adjustable pelvic harness and a body contoured Bolero jacket connected by four powerful corrective elastic bands. The pelvic harness acts as a foundation for the actions provided by the elastic bands. The body contoured Bolero aims to control the position of the trunk via the shoulders and lower rib cage. With assistance from special software, the bands are configured specifically to the patient and their indi-

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vidual curve characteristics. It is recommended to be worn for at least 20 hours per day. This form of bracing allows for a greater degree of movement and is easily concealed under clothing. However, it must be noted that its effectiveness in preventing curve progression is considered to be inferior to rigid forms of bracing such as the Boston brace.

Figure 5. A fully applied SpineCor brace, with pelvic harness, Bolero and 4 elastic bands

Recommended criteria for bracing

- Skeletally immature patient AND
- Curve measuring 25 to 40 degrees OR
- Curve less than 25 degrees but showing progression

The evidence

The strongest evidence to support bracing comes from the results of the landmark 'Bracing in Adolescent Idiopathic Scoliosis Trial' (BrAIST) published in 2013 in the New England Journal of Medicine. This highly regarded study was conducted to help answer the question about the effectiveness of bracing versus simple observation; with treatment success being the prevention of progression of scoliosis to 50 degrees (a threshold beyond which surgery is usually needed). The brace used in this study was a rigid TLSO brace. Children at high risk of progression were studied: 10-15 years of age, skeletal immaturity, and curves measuring between 20 and 40 degrees. The study reported a 75% success rate in the bracing group versus 42% in the observation group, and that for every three patients treated with a brace, one patient could be prevented from potentially requiring surgery. They also reported greater success rate if brace wear was for more than 13 hours per day.

Difficulties of bracing

Brace treatment should be continued until growth has been deemed to have stopped, with most full-time braces recommended to be worn for at least 18- 20 hours per day. Increasingly, evidence is tying the success of bracing with time spent wearing the brace. However, the major difficulty associated with bracing is the issue of patients following the recommended wearing periods. Wearing a brace is related to a combination of factors including anxieties around cosmetic appearance, discomfort from pressure points, restriction of activity, and irritation in hot weather. Patient education before starting brace treatment will help to overcome these difficulties.

Although increasing evidence is becoming available to support the use of casting and bracing in the management of scoliosis, it is important to remember that not all treatments are relevant to any one individual. Individual characteristics related to a particular child and their form of scoliosis will aid in deciding the most appropriate form of treatment. Casting and bracing is often unlikely to be successful in curves that are larger and more rigid. Children with underlying lung problems may not be able to tolerate casting and bracing because of the increased pressure this form of treatment applies to the chest wall. It is recommended to have a discussion regarding treatment options with a specialist at an early stage after a diagnosis of scoliosis is made.

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