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How the Use of a Scoliosis Compliance Monitor Improved Patient Care for Patients with AIS

The Role of Physical Therapy in the Treatment of AIS

Indications for Psychological Intervention with Patients Receiving Spinal Bracing

Sponsor's Editorial
The BOSTON BRACE 3D

Paul E. Leimkuehler
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How the Use of a Scoliosis Compliance Monitor Improved Patient Care for Patients with AIS

Clinical Scenario

A twelve-year-old girl who is in sixth grade presents for her first visit after starting a brace program to treat idiopathic thoracic scoliosis of 31 degrees.

In the past, I had found adolescent idiopathic scoliosis (AIS) treatment to be one of my most challenging patient encounters. The first visit establishes the tone of the bracing program, which will persist over the next twenty-four months of brace wear. Will our team approach of care be acceptable to the family with the patient-centered treatment being the focus of care?

The emotions vary with each patient. Will there be tears or withdrawal? Will the patient refuse to wear the brace or deny there is a problem? Or will there be strain between the parent and child? I have seen all these emotions, but I have also seen patients who show pride in their ability to adapt to the brace wear schedule, achieving an A grade on their brace monitor "report cards."

I like to equate the reading of the brace monitor to the quarterly report card teens are familiar with in middle school. Students often receive a rubric from their teacher at the start of a term. The rubric outlines the course requirements that must be met for the students to receive a certain grade for the term, so there are no surprises at report card time. With a temperature sensitivity brace monitor embedded in the orthosis, the exact amount of brace wear time can be determined. The patient will be responsible for choosing her grade for brace treatment of scoliosis.

I am a predictable and easy grader. My typical brace wear prescription for AIS treatment with a curve magnitude of 25–40 degrees is 18 hours per day. The patient will earn an A with 16–18 hours of brace wear per day, a B with 14–16 hours, and a C for 12–14 hours. I base the grades on the data from the Bracing in Adolescent Idiopathic Scoliosis Trial (BrAIST), which showed the dose-response aspect of effective orthosis wear.[1] In this randomized clinical trial with a patient preference arm, brace treatment and observation were compared for patients with an AIS curve magnitude of 20–40 degrees, with the primary outcome being curve progression to a surgical level of 50 degrees. The study confirmed the importance of brace wear time, as the results improved in accordance with hours in-brace. My grading based on the brace monitor data is rarely a surprise to the patient, although it is a surprise to some parents. I no longer hear the patient and parents argue about brace wear time, but I often hear parents acknowledge the challenges the teen faces in brace wear. I think of this as a teaching moment to discuss the obstacles that are preventing the patient from earning an A and an opportunity to ask the patient to generate her own ideas for improvement.

The patient-generated solutions keep the center of care with the patient. Involving the family in the solution will strengthen the plan of care and the family's commitment to supporting the patient in the brace wear program. Often, there is a plea from the patient to alter the brace in a manner that does not impact the efficiency of the brace, and these requests should be honored. There are other requests that should not be honored. However, I always want to keep the patient engaged with maximizing the hours of brace wear,

Figure 1. The iButton thermal sensor.

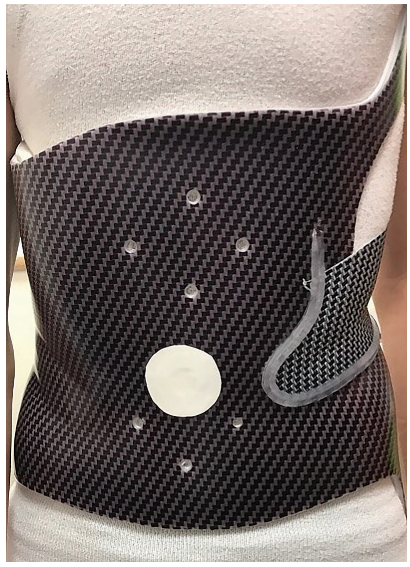
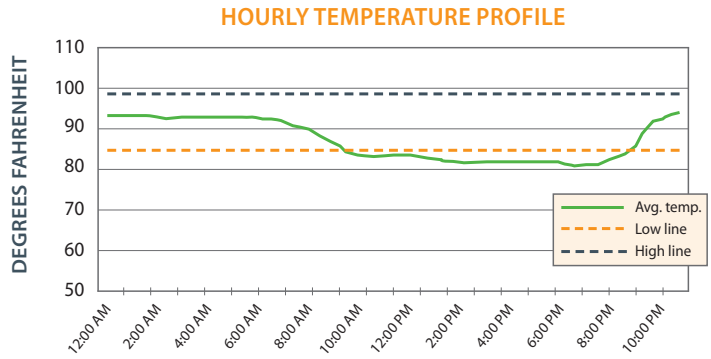


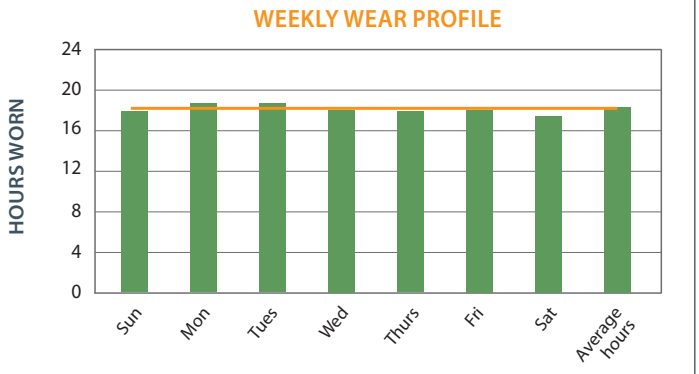
Figure 2. A Boston Brace 3D® with iButton installed.

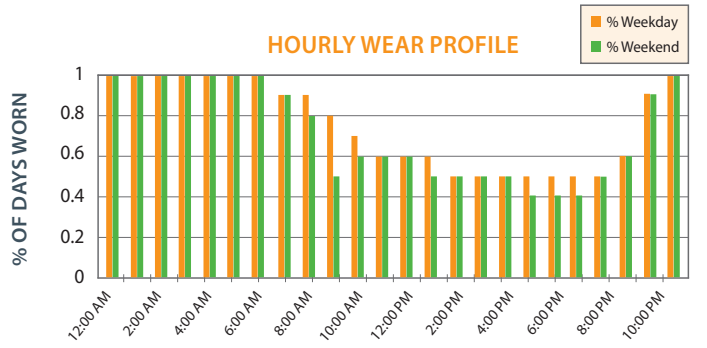
Figure 3. A Boston Brace 3D® adherence report.

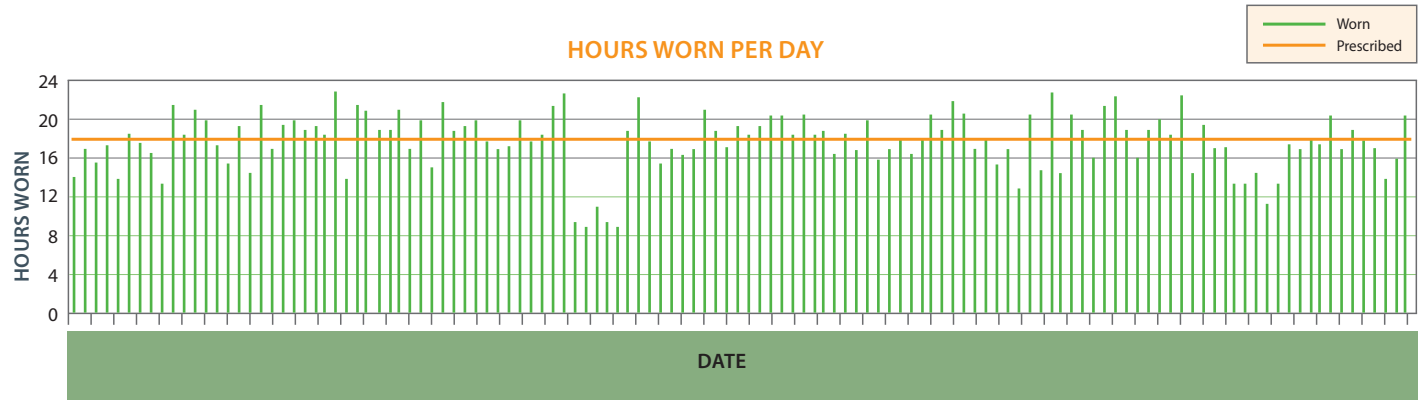
Patient name:	
Patient ID:	[redacted]
Patient DOB:	
Average hrs/day:	17.8
Prescribed hrs/day:	18
Start date:	[redacted]
End date:	
Days worn:	126
Brace type:	Boston Thoracic Brace

Excellent reports, very compliant. —Dr. Hresko









as brace wear time is the single most-documented factor that improves brace results. In-brace correction, strap tightness, and skin-contact area are all important secondary factors but are inconsequential if the brace is not being worn.

I have learned from treating teens with scoliosis and from my colleagues in Milan[2] that setting high expectations can achieve superior brace wear compliance, while setting low expectations will guarantee mediocre results.

References are available at www.oandp.org/page/ATcurrent.

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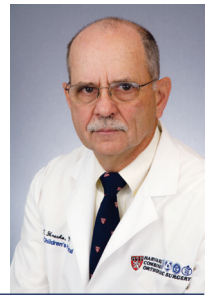

The Role of PHYSICAL THERAPY in the Treatment of AIS

Physical therapists are members of the multidisciplinary team who treat patients with adolescent idiopathic scoliosis (AIS), including patients who are treated with an orthosis.[1,2] Scoliosis-specific exercises (SSEs) have recently become more popular in the United States. A goal of physical therapy is to align the patient's head over the pelvis. This goal can be achieved by improving aesthetics of the trunk through postural awareness, muscle stabilization, and decreasing asymmetry due to muscle tightness. An additional goal of SSE is reduction of the Cobb angle.

A physical therapy evaluation includes a thorough postural assessment of the patient from the frontal and sagittal planes both in and out of the orthosis. From this assessment, the physical therapist can start to hypothesize muscle imbalances and asymmetries for further examination. Screenings for pain, skin integrity, leg length discrepancy, and respiratory pattern are also conducted. A manual muscle exam focused on the scapulae, hip, and abdominal muscles, as well as an assessment of muscle length focused on pectoral and hip musculature, is also required. These muscle groups can impact a patient's posture and should therefore be evaluated and addressed.

In addition, the angle of trunk rotation during a spinal range of motion assessment is helpful to track curve stability over time. Evaluating functional movements while the patient is wearing the orthosis and educating the patient on how to complete activities of daily living while wearing the orthosis are essential to ensure proper fit.

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Practicing activities like picking up an object from the floor in the orthosis and using a squatting technique rather than forward bending can decrease barriers to wear adherence during the weaning-in period.

An individualized home program is determined based on the findings of the evaluation. The home program is meant to be an adjunct to orthosis wear. Some patients initiate an SSE program with a physical therapist who has completed certification and training. The decision to initiate an SSE program is based on the patient and family's needs and wants. The exercise program is customized to the individual patient.

Studies have shown that SSEs decrease the angle of trunk rotation and Cobb angle.[3,4] Schreiber et al. showed that after three months of SSEs, back muscle endurance and pain scores improved. After six months of treatment, self-image scores also improved with SSEs.[5] A long-term study showed that the Cobb angle remained stable and, in some cases, decreased at skeletal maturity when SSEs were used in conjunction with orthoses.[6]

Providing exercises for the patient to complete both in and out of the orthosis addresses impairments and improves functional limitations while also demonstrating how to integrate use of the orthosis into the patient's life.[7] Patients who are not able to access SSEs can still benefit from physical therapy and should be encouraged to participate to address their impairments. Treatment should focus on core strengthening and postural awareness. The ability to achieve upright posture during functional tasks is required to advance strengthening exercises.

References are available at www.oandp.org/page/ATcurrent.

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THE BOSTON BRACE 3D

The Boston Brace 3D® orthosis is the natural evolution of the Boston Brace System used in the nonoperative team approach for the treatment of idiopathic scoliosis. This recent innovation came from reviewing the orthotists' outcome data from our Boston Orthotics & Prosthetics clinics. The clinical management team noticed that our New Jersey location was showing improved results compared to the literature and our other clinics. The New Jersey clinic had embraced scanning and had begun to develop a unique, internal corrective force manipulation of the patient's scan, creating an asymmetrical model over which the brace was fabricated. So, unlike the original Boston Brace, which is fabricated over a symmetrical model and then made asymmetrical through trimlines and padding, this brace has asymmetry built in, but it still allows for adjustments through pad placement and vector force.[1]

Figure 1 shows a transverse (top down) view of a single right thoracic curve. Note the patient's shape and rib prominence outlined in red and the intrinsic forces and reliefs that are created by symmetry (outlined in orange). This visual provides some insight as to why the original Boston Brace has been successful in treating idiopathic scoliosis.

These vector forces and relief areas can be enhanced (Figure 2) to the scanned model of the patient, thereby improving the in-brace reduction of the Cobb angle as shown in Figure 3. Much like the original Boston Brace, in which over 40 percent of patients have maintained some of their correction after bracing,[1] more than half of the Boston Brace 3D patients are maintaining some curve correction after bracing. We need to follow these patients in a controlled study to make any conclusions, but early results are promising.

When designing the Boston Brace 3D orthosis, we worked to enhance the principles that have proven effective in the original Boston Brace system. The advent of affordable scanning technology has allowed practitioners to introduce scanning into their practices and improve the patient experience. Scanning allows us to capture the true shape of the patient, in particular the patient's sagittal profile. Unlike the original Boston Brace, the Boston Brace 3D is not antilordotic; it works to achieve sagittal balance.

Scoliosis has long been recognized as a triplanar deformity, so all scoliosis bracing is triplanar. Rotational control along with Cobb angle improvement and sagittal balance were described by Watts and Hall in 1977 in one of the first papers on the Boston Brace.[2] By scanning the patient and modifying the scanned image in CAD, the clinician is ensured the intrinsic vector forces specific to that patient's needs are being met. These forces are then enhanced with strategically placed internal forces and reliefs specific to the patient's topography and X-ray analysis (blueprinting). This blueprinting is vital to the Boston Brace 3D. The central sacral line allows the clinician to assess compensation and decompensation, as well as the lateral deviation of the apical vertebra. This deviation is critical to determining the proper corrective vector forces. Knowing the dimensions of the pad and its proper orientation ensure the orthotist is providing the correct medial and anteriorly directed vectors to create the required resultant vector that will derotate and medially shift the spine while maintaining sagittal balance (Figure 4).

The patient's ability to wear the brace for the recommended hours per day has been established as vital to controlling curve progression.[3,4] Knowing this, Boston Orthotics & Prosthetics clinical specialists sought to find a way to objectively record the actual hours of brace wear. The iButton thermal sensor is a validated device that provides such data.[5] Prior to providing this thermal sensor as the standard of care to our scoliosis patients, we conducted a survey and asked the scoliosis parents and patients how they felt about using this technology. They told us they thought it was important to know the actual wear time and did not feel the thermal sensor was an invasion of privacy. We also know that scoliosis patients who know

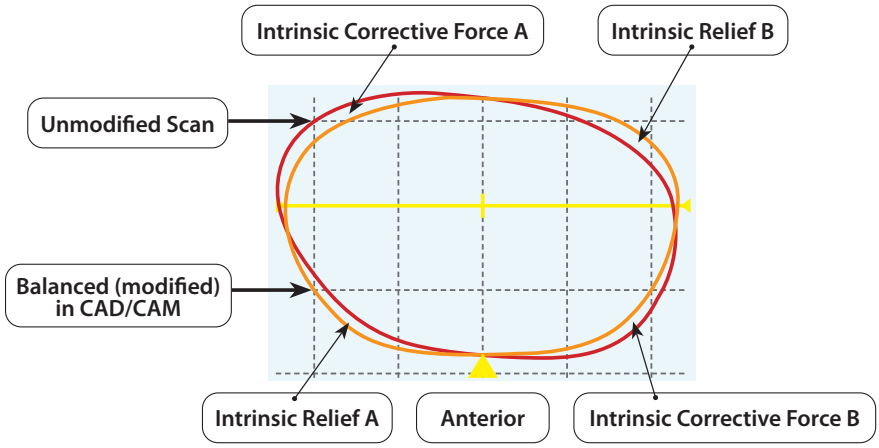

Figure 1. Original scan with symmetrized overlay.

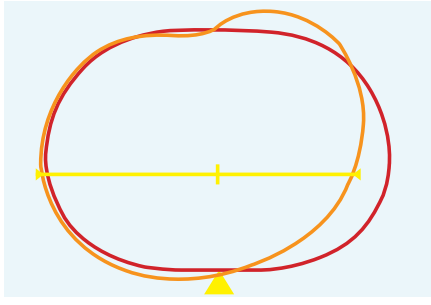

Figure 2. Original scan with enhance forces and relief areas overlay.

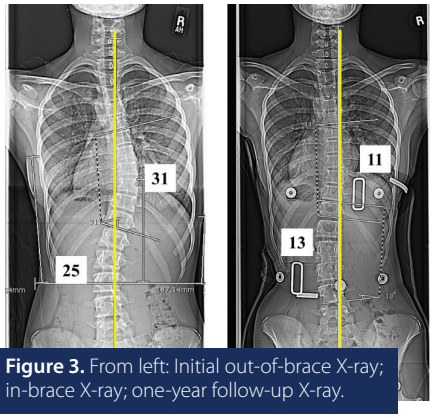

Figure 3. From left: Initial out-of-brace X-ray; in-brace X-ray; one-year follow-up X-ray.

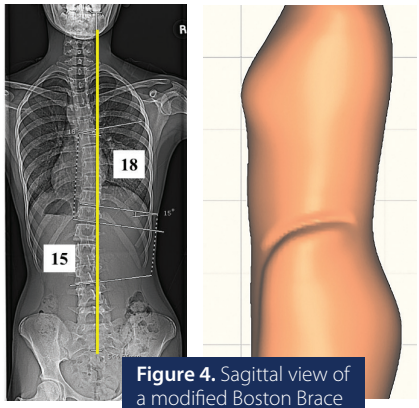

Figure 4. Sagittal view of a modified Boston Brace 3D scan.

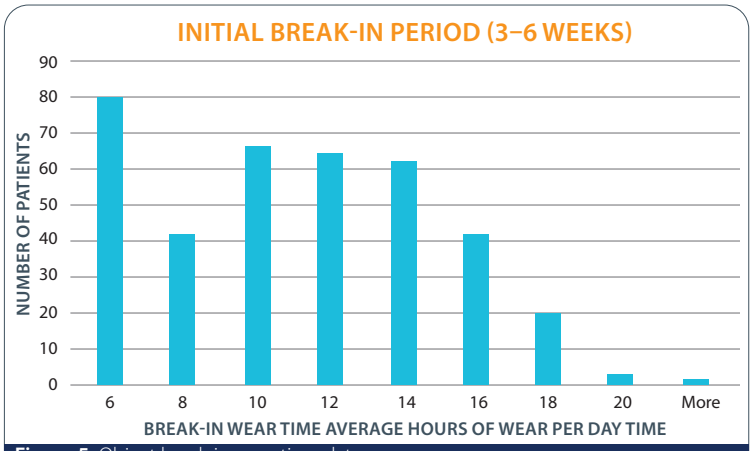

Figure 5. Object break-in wear time data

2019 Single Curves (222 patients)
Percentage of in-brace correction

Beginning Cobb Value Range	Thoracic (130)	Thoracolumbar (76)	Lumbar (16)
20 – 24	67	73	53
25 – 30	61	63	75
31 – 35	67	62	N/A
36 – 40	61	51	
41 – 45	46	N/A	

Table 1

2019 Double Curves (386)
Percentage of in-brace correction

Beginning Cobb Value Range	Primary Thoracic (241)	Primary Thoracolumbar (79)	Primary Lumbar (66)
20 – 24	64	64	55
25 – 30	53	52	55
31 – 35	46	42	51
36 – 40	41	40	43
41 – 45	32	N/A	46

Table 2

their brace wear is being monitored and are provided a report have better adherence.[6] This is why all Boston Brace 3Ds come standard with an iButton. M. Timothy Hresko, MD, discusses the clinical impact of the use of compliance monitors with scoliosis bracing in his article, "How the Use of a Scoliosis Compliance Monitor Improved Patient Care for Patients with AIS," on page 7.

The Boston Brace 3D has several design options—the first being the opening, which may be anterior or posterior. The posterior opening is standard to the Boston Brace 3D so that our clinicians can evaluate the lumbar derotational pad position and vector force. It also allows orthotists to palpate the spinous process to assess if the patient is midline, indicating the curve is more midline. We surveyed our past scoliosis patients and asked questions about their bracing experience in an effort to improve our current procedures and brace design. One of the questions asked the patient if he or she was able to self-don the orthosis. Most of our patients could self-don and stated they liked having the straps in the back because it did not show under their clothing. Other options include the inner lining; the Boston Brace 3D may be fabricated unlined or partially lined depending on the patient's presentation and/or preference.

We have adapted our shape-capture and modification techniques using the latest technologies available. This has helped us achieve positive results and maintain quality despite healthcare reimbursement constraints. The Boston Brace 3D is a cost-effective solution for patients and clinicians alike.

We continue to monitor our results and are pleased with the in-brace correction percentages and hours of wear achieved by our patients. Tables 1 and 2 show our 2019 average in-brace curve reduction by curve type and initial Cobb angle. These tables are based on 608 patients seen in our clinics. Figure 7 shows the average initial hours of wear during the break-in period. This is based on 381 first-time brace wearers who opted to have an iButton installed into their orthosis. This data was prospectively collected from our 26 clinical care offices on consecutive patients and was reviewed retrospectively. Curve type and initial out-of-brace Cobb angle is provided along with the initial in-brace correction percentage. Our double curves also show positive correction values, but we are developing techniques to improve these results.

Training for the Boston Brace 3D is available online at https://education.bostonoandp.com. This eLearning platform allows busy clinicians to learn at their convenience. Our expert certified clinicians are available to assist orthotists during the initial evaluation, scanning, and fitting. Please contact us at www.bostonoandp.com/contact for further information regarding the Boston Brace 3D and training.

References are available at www.oandp.org/page/ATcurrent.

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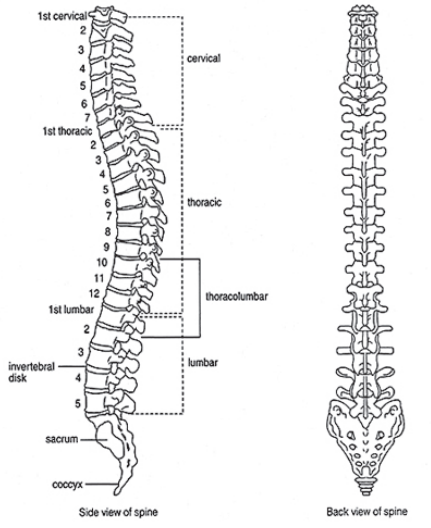
NO. 1

How many orthotists are in this picture?



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