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The R-Wrap AFO: An Old Concept, A New Application

By Beverly Cusick, MS, PT, BOC

Orthotist, John Russell, CPO, BOCOP, CPO, BOCOP

Anne Russell, MA, PT. John G. Russell Jr.

Academic Degrees

AA.

Primary affiliations

Collier Rehabilitation Systems
Inc.

Complete address

3161 Putnam Blvd.

Phone

925-943-1119

The funding for this work is from the operating expenses of Collier Rehabilitation Systems Inc. The warranty for the standard AFO at Collier Rehabilitation Systems Inc. has been the driving force for the creation of this new design.

The purpose of this article is to introduce the orthotic community to a new 2-piece style of AFO, called the R-wrap AFO, which has been successful in treating patients with UMNS who have supinatory foot deformities related to dominant, synergistic muscle activation patterns. More than just an orthotic design, the R-Wrap AFO is part of a treatment approach used by orthotists, physical therapists and physiatrists at a large rehab facility in Northern California. The collaboration of this rehab team has evolved a set of standards to select appropriate candidates for this AFO. The R-Wrap AFO has contributed toward shortened hospital admissions by reducing contractures, controlling synergistic patterns of the foot and ankle, thereby improving function in transfers and/or gait. This article briefly describes the AFO, its rationale, and also describes a preparatory AFO that is sometimes used to reduce contractures prior to casting. The article presents the evaluation-screening tool used by the rehab team. Follow-up on the R-Wrap AFO users showed that after using the AFO for months, 8% improved in function adequately to be advanced to a new articulating style of the R-Wrap AFO.

The 2-piece, polypropylene, R-Wrap AFO is used primarily for clients with upper motor neuron syndrome (UMNS) due to traumatic brain injury or cerebral vascular accident. Depending upon the timing of orthotic intervention, the unique design features of the R-Wrap AFO have offered hundreds of patients with UMNS both prevention and effective management of the particular foot deformities common to the syndrome. The design of the AFO also succeeds in controlling the painful spasms that are related to dominant, synergistic muscle activation patterns.¹ During the seven-year period between 1994 and

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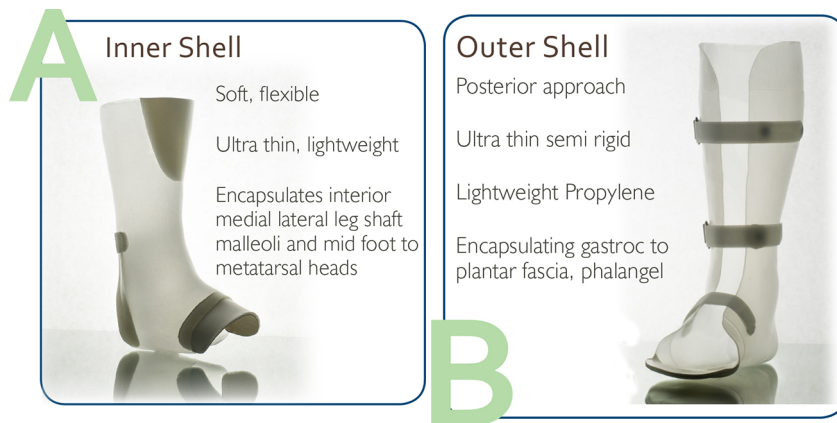


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2001, since John Russell, CP and BOC orthotist, had completed the development of the R-Wrap design, 689 of these braces were delivered to 584 patients, the majority who were patients at Kaiser Foundation Rehabilitation Center. (Some of the braces were for patients with bilateral deformities and some got two R-Wrap AFOs) The success of its clinical application and follow-up has led physical therapists and physiatrists at that facility to evolve a set of evaluative criteria that identifies the patients who can be expected to benefit from wearing the R-Wrap AFO.

Two features of the R-Wrap resemble a below-knee serial cast:



- 1.) The total contact design feature, assuring optimum comfort by applying alignment forces to the foot and ankle over the greatest possible surface area.
- 2.) It captures and immobilizes the calcaneus and the talo-crural joint securely while allowing small increments of movement of the leg and forefoot.

However, the R-Wrap AFO is removable and remarkably lightweight, as it is typically made with polypropylene, using a thickness of $< 3/32$ ". Deformities that require treatment of contractures prior to orthotic intervention can be prepared with the application of one or more Flexcast Preparatory AFO's, in the manner of serial casting.^{2,3}

In customizing the R-Wrap AFO through special casting and modification techniques, the foot alignment of each patient is kept at a familiar and comfortable position, rather than submitting it to an aggressive correction of the alignment.^{4,5} Inherent in the design of the AFO is some degree of transverse-plane flexibility that seems to contribute to the high level of comfort reported by patients.^{1a} The intimate fit of a polypropylene device is achieved by the appropriate use of the specialized pads that fill the sulci beside the Achilles tendon. Flexibility of the forefoot, specifically at the MP's, allows some sagittal-plane motion, which assists with the toe off phase of the gait cycle. The application of pressure to the Achilles

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tendon by the same pads may reduce H-Reflex amplitudes in the calf musculature, or hyperreflexia.⁶

A group of physical therapists at KFRC, primarily Karla Nubling P.T., and Sharon Nicholas P.T. (retired), joined John Russell in developing an orthotic evaluation protocol. (Figures 1) The orthotic assessment is completed for each neurologically impaired patient at the appropriate time following a brain insult resulting in UMNS. Many physiological signs are recorded and monitored at each meeting with the physical therapist and orthotist. Through clinical experience and hundreds of trials, the rehab team has created an orthotic evaluation designed to detect three physiological signs that serve as reliable indicators for which orthosis is most appropriate. The presence of 2 out of the 3 signs may result in a prescription for an R-Wrap AFO. The criteria are as follows:

- 1.) More than four beats of clonus.
- 2.) Active or volitional foot and ankle motion that occurs only in conjunction with abnormal synergistic patterns. These patterns can be in any of three muscle groups: plantarflexors, dorsiflexors or peroneals. The synergistic patterns must not simply be present; they must be strong enough to show up when the muscle works against gravity.
- 3.) Loss of passive ankle dorsiflexion (DF) range of motion (ROM) with the knee flexed or extended (usually observed by comparing the affected ankle to the DFROM available in the opposite ankle.)

Table 1. Partial Evaluation form used at the period of time of these statistics.

Orthotics Evaluation Sheet

Section I		(PT. fills in prior to orthotist consult)	
Patient Diagnosis: _____		Onset: _____	
Discharge City: _____		DC Date: _____	
Tone:		<input type="checkbox"/> Yes	<input type="checkbox"/> No
Clonus:		<input type="checkbox"/> Yes	<input type="checkbox"/> No
Tone over time: Decreases:		<input type="checkbox"/> Increases	<input type="checkbox"/> Decrease
Fatigue or Gait Deterioration over time:		<input type="checkbox"/> Yes	<input type="checkbox"/> No
Muscle imbalance:		<input type="checkbox"/> Yes	<input type="checkbox"/> No
What muscle group (e.g. ant. tibia) _____			
Sensory Loss _____		Perceptual Problems _____	
DECREASED ROM OF FOOT			
Walks with knee flexed:		Degrees _____ °	
Hyperextend knee during gait:		Degrees _____ °	
KNEE CONTROL			
Walks with knee flexed		<input type="checkbox"/> Yes	<input type="checkbox"/> No
Hyperextend knee during gait:		<input type="checkbox"/> Yes	<input type="checkbox"/> No

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Using these criteria, the patients who met the 2 out of 3 of these physiological indicators were fitted with the R-Wrap AFO. These patients typically improved in ambulation and/or ability to perform transfers with full weight bearing on the lower extremities. Relatively few revisions were necessary, and when revisions were needed, they were often necessary because ankle DFROM had improved and volume had increased at the ankle. Russell reduced the need for orthotic revisions due to ROM and limb volume increases by developing and using the Flexcast Preparatory AFO system, which reduces static or stiff ankle plantar flexion contractures prior to casting for the R-Wrap AFO.

Appropriate use of the R-Wrap AFO can improve the “bottom line” for health care providers by contributing to decreased length of stays in the rehabilitation facility while improving functional outcomes. The rehabilitation team at KFRC considers the R-Wrap AFO to be a major factor in getting patients with severe hypertonus up sooner, either walking or improved in transfers. Patients who have tried other orthotic designs usually prefer the R-Wrap, reporting that the latter is more comfortable and more effective in controlling hypertonicity and involuntary movements than other types of ankle-foot orthoses, including ‘clam-shell’ designs. In addition, skin problems associated with wearing the R-Wrap are rare. The only complaint with the R-Wrap AFO is the donning process. Therapists need to spend extra time teaching the caregiver/patient how to don/doff the AFO and have learned certain techniques that make the process more successful.

Of the 584 R-Wraps users, 54, or about 8% of this group, eventually progressed to an articulating style of the R-Wrap AFO after 1-2 years of wearing and using the standard R-Wrap AFO. Because they experienced increased function, time up walking, and improved ankle and foot joint mobility, these patients advanced to the articulating R-Wrap (AR-Wrap) AFO, which permits a few degrees of ankle DF motion by providing a total-contact, intrinsic ankle joint. It is doubtful that these positive changes would have been possible without a preliminary orthotic system that had effectively managed their muscle tone, was comfortable in restoring functional foot and ankle alignment, and had contributed to a gain in ankle DFROM. Some of the delay is also attributable to lack of follow-up visits for outpatients who lived far from the medical offices. After just 6 weeks of use, improvement in ankle range of motion among some R-Wraps users has been significant enough to progress them to an AR-Wrap AFO.

The R-Wrap AFO has been very successful as a means of comfortable control for the abnormal patterns of movement common to UMNS, thereby allowing improved function. As with many neurological problems, early recognition and treatment of the motor problems usually yield better results, by preventing the abnormal patterns from becoming

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habitual.^{4a} Topics for future study are identification of the best time to progress the patient to a more advanced, articulating model of the R-Wrap AFO, called the AR-Wrap, which gives the ankle greater degrees of motion, but still controls the rotary problems of the ankle.

Authors:

Beverly Cusick, MS, PT BOC Orthotist, is President of Progressive Gaitways Inc., 536 Society Dr., Suite C-3, Telluride, CO 81435-8902.

John G. Russell Jr., CPO, BOCOP, is President of Collier Rehabilitation System Inc., 3161 Putnam Blvd, Pleasant Hill, CA 94523.

Anne Russell, MA, PT, is affiliated with Kaiser Home Health Agency, 200 Muir Road, Martinez, CA 94553.

1 Cusick, Beverly. Serial Casts: Their use in the Management of Spasticity-Induced Foot Deformity, revised edition. Tucson: Therapy Skill Builders; 1990.

2 An instructional, "how-to" Flexcast© Preparatory AFO fabrication videotape is available, with an accompanying monograph explaining the pathophysiology of foot deformity related to UMNS. For ordering information, contact <http://www.gaitways.com> or Progressive GaitWays, LLC, PH/FAX: 970-728-7078.

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