

Current Concepts on Bracing in the Ponseti Method

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ABSTRACT

The Ponseti method has become the gold standard for the treatment of clubfoot, with excellent long-term functional outcomes. Adherence to the bracing protocol is essential for the long-term success of the treatment. Currently, there are multiple braces that can be used to prevent relapse. In this article, we provide a review of clubfoot braces, discussing their advantages and disadvantages, as well as the current evidence on each of them.

Keywords: clubfoot; Ponseti; brace; relapse.

Level of Evidence: V

Conceptos actuales sobre el tratamiento ortésico en el método Ponseti

RESUMEN

El método Ponseti se ha convertido en el patrón de referencia para el tratamiento del pie bot, con excelentes resultados funcionales en el seguimiento a largo plazo. El cumplimiento del protocolo de férula es fundamental para mantener la corrección obtenida y el éxito terapéutico a largo plazo. Existen múltiples férulas para mantener la corrección y prevenir la recurrencia. En este artículo, proporcionamos una revisión de las férulas utilizadas para el pie bot, y analizamos sus ventajas y desventajas, así como la evidencia sobre cada una.

Palabras clave: Pie bot; Ponseti; ortesis; recurrencia.

Nivel de Evidencia: V

INTRODUCTION

The Ponseti method has become the gold standard for the treatment of clubfoot, with excellent functional outcomes in long-term follow-up.¹ It consists of a series of manipulations and casting every 5-7 days, using a specific technique, generally combined with a percutaneous Achilles tendon tenotomy.^{2,3} After removing the last cast, an abduction orthosis is indicated to maintain the correction. Proper orthotic protocol generally requires the child to wear the brace 23 hours per day for the first 3 months after cast removal and then during the night and naps (approximately 12-14 hours) until 4 or 5 years old. Compliance with the orthotic protocol is essential for the long-term success of treatment, and is a better predictor of recurrence than the severity of the deformity at birth.^{4,7}

In this article, we provide a review of braces used for clubfoot, and discuss their advantages and disadvantages, as well as the evidence on each.

RECOMMENDATIONS

According to the recommendations of the Ponseti method, once the foot has been corrected, it should be kept in a brace that places it in an abduction and dorsiflexion position to prevent recurrence of the deformity. Ideally, the bar connecting the shoes should be bent to allow 10° of dorsiflexion and allow for progressive heel width adjustment as the child grows. The splint must also allow movement of the hip, knee, and ankle. These movements are necessary for the development of the muscles of the lower limbs and to prevent recurrence.²

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TYPES OF BRACES

There are three main categories of brace designs used for clubfoot: 1) ankle-foot orthoses, 2) Wheaton-type orthoses, and 3) abduction braces.

1) Ankle-Foot Orthosis

This orthosis fully covers the foot and ankle, thereby providing only dorsiflexion which is typically set to neutral (0° dorsiflexion). Notably, it does not provide abduction, which is important for the elongation of medial structures. Also, the lack of movement in the ankle contributes to calf muscle atrophy which is already abnormal in clubfoot patients. The results of using a unilateral ankle-foot brace after treatment with the Ponseti method have been disappointing, with a high recurrence rate.⁸ However, this brace may be useful in combination with an abduction bar in specific circumstances, particularly when the child has limited dorsiflexion and minimal muscle support (myelomeningocele, arthrogryposis, fibular nerve dysfunction, etc.). In cases where full-time orthotic use is necessary to provide the necessary support, ankle and foot braces may be an option.

2) Wheaton brace

This orthosis and other devices based on a similar design can provide some abduction of the foot. It has multiple disadvantages: it is expensive because it is custom-made, it requires fairly frequent adjustments, and because it reaches up to the thigh, it can promote atrophy of the calf and thigh muscle. To the best of our knowledge, there is no evidence to support its efficacy, so it is not recommended for the treatment of clubfoot.

3) Abduction braces

These orthoses are an evolution and adaptation of the orthosis described by Denis Browne in 1931.⁹ Several designs are marketed (Figure 1):

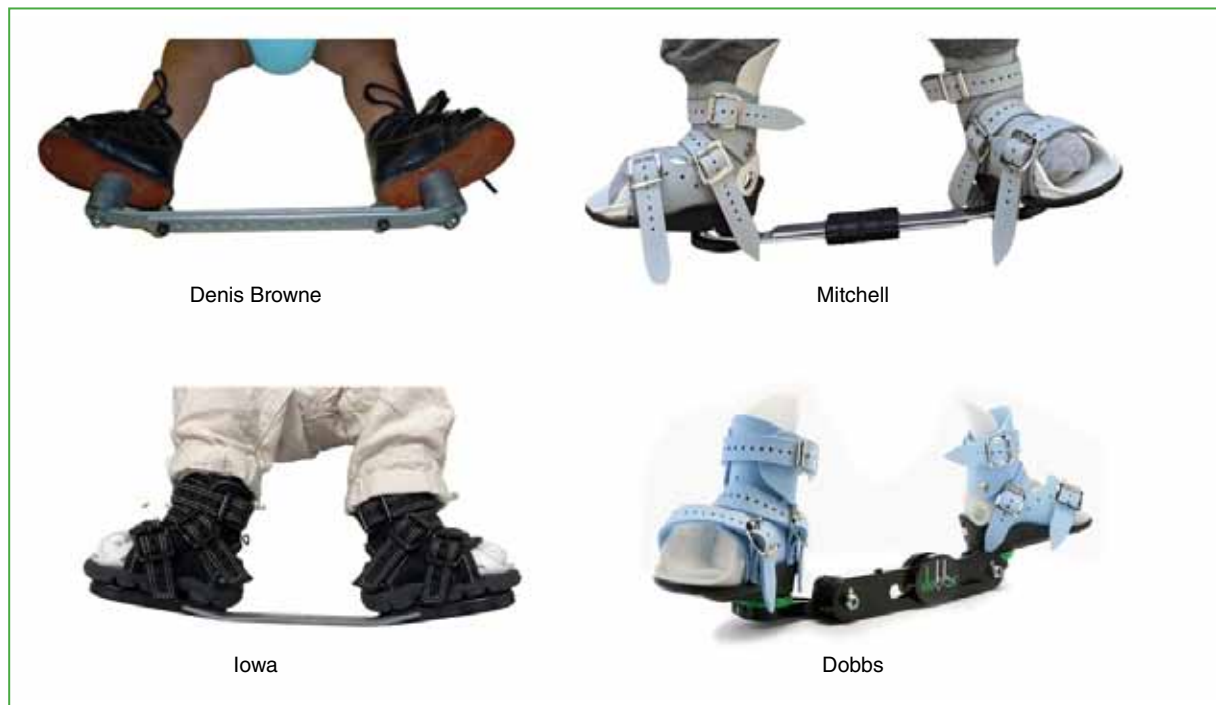


Figure 1. Abduction braces for the treatment of clubfoot.

- Denis Browne – It has a dorsiflexed foot brace attached to leather boots. The toe and heels can be opened to check if the foot is plantigrade.

- Markell Shoes (C-Pro Direct, Kent, UK) – These are symmetrical shape shoes and are designed to work with the Denis Browne bar.

- Steenbeek – This brace was developed in Uganda and is made using local tools. It is quite affordable and meets all the requirements for braces after the Ponseti cast. It is used in many clubfoot programs that take place in developing countries in Africa and Asia. Bouchoucha et al.,¹⁰ and Gupta et al.¹¹ reported excellent outcomes with this brace in Tunisia and India.

Horton Click (MJ Markell Shoe Co, New York, USA) – This system uses a shoe that can be easily clicked into the bar and allows for internal and external rotation of the foot.

Mitchell – This brace, also known as the Ponseti™ FAB, was developed to provide a more comfortable shoe alternative to improve treatment compliance. The shoes are sandal-type leather footwear with a molded soft thermoplastic elastomer lining that prevents slipping of the foot. They have a quick release mechanism to make it easy to remove the shoes from the bar, making them easy to put on and take off. These shoes are relatively expensive. Zions et al.¹² evaluated 57 patients (84 feet) who used this device after correction. 60% complied with the protocol. Eight (14%) had skin problems; in six of them, it was a superficial abrasion of the dorsal skin. At last follow-up, all feet were plantigrade and at least 10° dorsiflexed. None required surgical releases. Of the 31 patients monitored for at least three years, 26 (84%) used the brace for at least three years. Recently, the manufacturer (MD Orthopaedics - Orthopediatrics) introduced a dynamic bar called MP-Move that allows independent movement between limbs and potentially improves comfort (Figure 2). The boots have a wedge incorporated in the heel area with the 10° dorsiflexion required to prevent recurrence.



Figure 2. MP-Move dynamic bar (Md Orthopaedics - Orthopediatrics).

- Iowa – Designed by a team of specialists, directed by Dr. José Morcuende from the University of Iowa. It has a fixed 60° abduction angle for the affected ankle. The bar is not adjustable, but it comes in three lengths: 8, 10 and 12 inches. The connecting bar is called the Flex Bar because it provides some limited movement when the child moves the lower limbs, but always returns to the desired position when the patient relaxes.

- Kessler – The bar is flexible to allow the child some plantarflexion during kicking and then returns to the original dorsiflexed position once the child stops kicking.

- Dobbs (D-Bar Enterprises, LLC, St. Louis, USA) – The bar allows the child to move both legs independently, but dorsiflexion can be difficult to achieve. These bars are compatible with Mitchell Ponseti or Markell shoes, or a custom molded solid AFO. The bar is relatively expensive. Chen et al.¹³ evaluated 28 patients (49 feet) treated with

a dynamic abduction brace. They reported a lower non-compliance rate than with the traditional Denis Browne brace (7.1% vs. 41%). Seven percent of the patients who used the dynamic orthosis suffered skin lesions, in contrast to the 23.5% observed with the traditional abduction brace. Garg and Porter¹⁴ published similar results with higher compliance, fewer recurrences, and fewer skin complications when using the dynamic brace.

- 3D-printed braces – Recently, 3D-printed braces have been developed using open source technology. These braces have similar features to others available on the market, but their cost is significantly lower. This would make them particularly suitable for use in developing countries.¹⁵

- Unilateral Designs: Some authors have attempted to use unilateral orthoses due to compliance issues. Published results are limited, but have generally been inferior to standard bilateral splints as they do not provide abduction.^{8,16,17} Recently, a unilateral brace called the ADM brace from C-Pro Direct (7A Enterprise Way, Edenbridge, Kent, UK) has been launched on the market. This brace has a dynamic mechanism that provides active dorsiflexion and abduction without the need to use a bar that joins both feet. It can be worn on one foot or both feet, so it would have the potential advantage of providing more comfort. However, Mahan et al.¹⁸ published their initial experience with this orthosis, reporting that almost half of the patients did not tolerate it for the prescribed time.

All available abduction braces that meet Ponseti's recommendations can be used to prevent recurrence of the deformity. The type of brace and the brand are not important as long as they follow the principles and recommendations of the method.

Compliance monitoring

Some authors have described the use of pressure or temperature sensors to monitor how long the braces were worn. This information could improve our practice as has occurred in the treatment of idiopathic scoliosis.¹⁹⁻²¹ Morgenstein et al.²² used pressure sensors and observed a rapid decrease in the time of wear in the first months and a significant discrepancy between the time of wear reported by the parents and the actual time of wear. Sangiorgio et al.²³ used wireless temperature sensors and observed that parents applied the brace only 62% of the prescribed time. In addition, they reported that patients who wore it for at least 8 hours per day had a lower risk of recurrence than those who wore it <5 hours per day. Richards et al.²⁴ confirmed these findings in a recently published case series. The potential advantages of monitoring the time of wear could be related to better compliance and better control in those patients with a higher risk of recurrence, which would lead to better outcomes.

How to improve compliance?

There are multiple strategies that can be applied. It is important to achieve complete correction of the deformity, ensure optimal brace comfort, and educate parents on the importance of this stage. Parents need to understand the mechanism by which the orthosis decreases the risk of recurrence and how to use it. The treating physician must continually reinforce the concept that the brace is essential to the child's recovery and that, without it, the chances of requiring a new series of casts or surgery are high. There are obstacles that exceed the doctor or families, such as financial difficulties or the distance to the treatment center. It is important to recognize these limitations, discuss them with the family, and try to resolve them.

CONCLUSIONS

The use of the abduction brace is essential to prevent relapse in patients treated with the Ponseti method. The type and brand of the brace are not important as long as they comply with the recommendations suggested by Ponseti. Future research should focus on increasing patient comfort and satisfaction to improve compliance, and on reducing the cost of orthoses to make them accessible. Likewise, the development of more advanced technology to monitor the use of the brace could allow us to make observations that modify our current practice.

Conflict of interest: The authors declare no conflicts of interest.

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