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**CASE REPORT**

# ORTHOTIC FITTING IMPROVES GAIT IN A PATIENT WITH GENERALIZED SECONDARY DYSTONIA

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***Objective:*** **To determine whether an orthotic fitting improved gait in an adult patient presenting with generalized secondary dystonia.**
***Patient:*** **The patient had stance and gait disturbances associated with pain, ankle instability and fatigability. Clinical examination showed the presence of dystonia in the foot and ankle, along with equinovarus foot, mainly on the left side. The patient was fitted with a patellar tendon-bearing orthosis on the left side, orthopaedic shoes and plantar orthoses.**
***Methods:*** **The outcome of the treatment after 12 months was assessed on the basis of a physical examination and an instrumental gait assessment, using the GAITRite® system to analyse spatiotemporal parameters and force-plates to measure body weight distribution.**
***Results:*** **The fitting resulted in a significant improvement in gait, reduced pain and ankle instability, decreased cadence, increased step length and single foot support time, and reduced asymmetry of the temporo-spatial patterns and body weight distribution.**
***Conclusion:*** **Patellar tendon-bearing orthoses and orthopaedic shoes could provide a good therapeutic approach for improving gait in patients with generalized secondary dystonia.**

*Key words:* dystonia, orthosis, orthopaedic shoes, gait.

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## INTRODUCTION

Dystonia is a movement disorder resulting from basal ganglia dysfunction, which is characterized by sustained involuntary contractions causing repetitive twisting movements and/or abnormal posture. Secondary dystonia is a similar syndrome due to an underlying neurological disease (1).

The treatment strategies available include pharmacological, surgical and supportive approaches (2). Physical therapy is a useful adjunct to medical treatment (3). To our knowledge only 3 studies have been published to date on orthotic fittings applied to the lower limbs of adult patients with dystonia (4–6). These are all case studies showing that these fittings improved the patients' ability to walk, but they do not include quantitative gait assessments.

The aim of this case study was to determine whether an orthotic fitting with a combination of orthopaedic shoes, plantar orthoses and a custom-made patellar tendon bearing orthosis would improve the gait of an adult patient with generalized secondary dystonia. Improvements in gait were assessed clinically and by quantified measurements.

## CASE REPORT

### *Subject*

The patient was a 44-year-old man with generalized secondary dystonia predominating on the left side due to the occurrence of post-pertussis encephalitis when he was only 15 days old. There were no other personal medical antecedents.

Previous treatments were: pharmacological agents (no effect); follow-up at a rehabilitation centre from the age of 2 years to adolescence (no recent physiotherapy); orthopaedic shoes combined with a metal-sided ankle calliper on the left side from the age of 3 to 14 years, and orthopaedic shoes again from the age of 35 to 42 years; and surgery on the left ankle tendon at the age of 35 years (no further details available).

The patient's complaints focused on the left side: pain (painful ankle instability combined with pain under the foot and in the calf during the stance phase of gait), ankle instability during the stance phase and forefoot stumbling during the swing phase.

Neurological examination showed dystonia of the ankle and toes (dystonic equinus varus foot) and no sensory impairments. The orthopaedic impairments consisted of pes cavus with equinovarus of both feet, mainly on the left side (equinus of the left talo-crural joint with the knee extended at an angle of –45°; and with the knee flexed at an angle of –15°) (Fig. 1). The ankle varus on the left side was completely reduced with the knee flexed and and partially reduced with the knee extended. Accurate measurements of articular laxity and muscle strength were very difficult to obtain because of the involuntary movements made by the patient, but no significant lack of strength or laxity of the subtalar joint was observed.

Barefoot upright stance without any assistance was very difficult for the patient, since the left foot was supported only by the 3 lateral toes (Fig. 1). The patient did not practise


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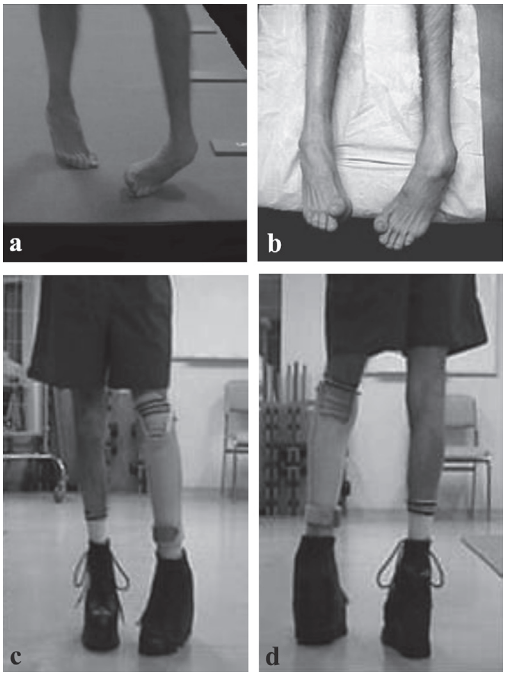


*Fig. 1.* The patient's equinovarus foot during gait (a) and while lying down (b) without the fitting. The patient with the orthotic fitting, front (c) and back (d).

barefoot gait. He used orthopaedic shoes to walk both inside and outside, without any supporting devices.

The patient's activities were limited and his participation was restricted in all situations involving sustained gait or upright stance, both in his personal life and at work. The patient stated that his quality of life would be improved if he could go shopping with his wife, walk in the countryside, attend football matches, and feel less fatigue and pain.

Two therapeutic options were available for reducing the pain and stabilizing the ankle: an orthotic fitting or surgery. The possibility of surgery was discussed at a multidisciplinary consultation, and a double arthrodesia associated with tendon lengthening was thought to be theoretically plausible in order to restore plantar support, steady the foot and ankle and reduce the mechanical restraints resulting from the equinovarus. The patient decided to postpone surgery for family reasons and opted for the orthotic fitting.

*Description of the orthotic fitting*

The aims of the fitting (Fig. 1) were as follows:

- The patellar tendon-bearing (PTB) orthosis was designed to control the varus instability when loads were applied, to reduce the weight borne by the skeletal foot and ankle structures, and to reduce the constraints and pain.
- The plantar orthoses were designed to compensate for the equinus by promoting heel-contact and improving the weight distribution.
- The orthopaedic shoes (7) were designed to increase ankle stability and provide a large base support area.

The PTB (8) was made with 2 polypropylene shells: an anterior shell bearing on the patellar tendon and a posterior shell with a counter-bearing placed in the popliteal fossea (Fig. 2). Orthopaedic shoes and plantar orthoses were made to measure using a plaster copy prepared from a mould of the patient's feet and corrected as appropriate. On the left side, moulding was performed on the patient wearing the PTB brace (Fig. 2). The shoes had a rising stem with high buttresses and a front rocking sole with lateral heel-widening. The left plantar orthosis had a rising lateral buttress, and an additional front-fitting was added after the moulding was completed (Fig. 2). The total weight of the fitting was 1.6 kg.

*Assessment*

Complete clinical assessments were performed before fitting and one year afterwards. The patient's complaints, impairments (neurological and musculoskeletal), activities (gait) and participation were assessed. The Functional Independence Measure (FIM™) and the Functional Ambulatory Classification (FAC) scores were determined.

An instrumental gait assessment was performed with the GAITRite® (CIR Systems, Inc. Havertown, PA, USA) system (9), which can be used to measure the temporal and spatial parameters of gait. The GAITRite® system is a roll-up carpet with approximately 14,000 piezoelectric sensors on an active area 427 cm long and 61 cm wide. The acquisition frequency is 80 Hz. As the patient walks along the carpet, the system captures the geometry and the relative arrangement of each footfall as a function of time. The quantitative gait assessment was performed mainly in order to check whether the fitting had improved the patient's gait effectively. The patient was asked to

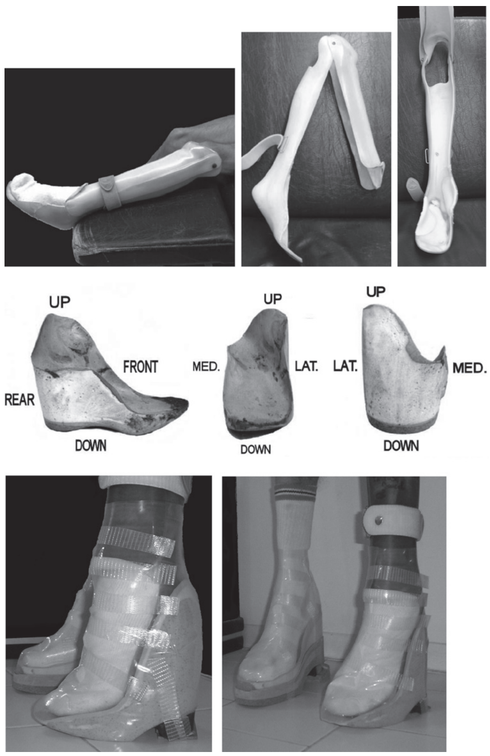


*Fig. 2.* Details of the fitting: (upper panel) patellar tendon-bearing (PTB) orthosis; (middle panel) plantar orthosis; (lower panel) patient with plantar orthosis and PTB brace.

walk barefoot at his own speed, and then with the fitting, which he had been using for one year. Body weight distribution analysis was performed barefoot and with the orthotic fitting using 2 Advanced Mechanical Technology, Inc. (AMTI, Watertown, MA, USA) force plates.

## RESULTS

The main clinical and quantified changes induced by the fitting are summarized in Table I and Table II, respectively.

The patient walked outdoors at least once a day without any assistance. The patient did not need to concentrate while walking, but he avoided walking on uneven ground. The ankle instability and pain in the foot and calf decreased, but one year after the fitting procedure was completed, the patient reported that the PTB orthosis was causing pain in the lateral malleolus region.

Clinical gait analysis under barefoot conditions showed the occurrence of a very high cadence and an asymmetric gait. On the left side, contact was made only with the lateral part of the forefoot during the stance phase, and the foot remained in the equinovarus position during the swing phase. Clinical gait analysis with the orthotic fitting showed that the cadence decreased and the gait was less asymmetrical. On the left side, during the stance phase, the initial contact was made with a flat foot, in line with the loading occurring under the mid-foot due to the fitting.

## DISCUSSION

In the case of this patient with a disabling pathology where other treatments had failed, an orthotic fitting applied to the lower limbs efficiently restored upright stance and gait. An appropriate orthosis can enable a severely impaired dystonic patient with severe deformities to continue to walk.

This improvement was assessed objectively, both qualitatively in a clinical study, showing that the patient's pain and instability had decreased and that his gait pattern had improved, and quantitatively in an instrumental analysis, showing that the cadence and the asymmetry of the step length and that of the single foot support had both decreased. The left lower limb loading parameters had also improved. The body weight distribution on the left side increased because the PTB loaded the body weight onto the patellar tendon and tibial condyles and unloaded the ankle/foot complex, thus decreasing pain and instability. To our knowledge no quantitative gait assessments have been published to date on patients with dystonia who are equipped with fittings. The main difference in equinus varus foot associated with dystonia compared with upper motor syndrome is the repetitive twisting movement. Fittings must be applied carefully because of the risk that the orthosis may cause lesions due to the repetitive twisting movements, and the treatment is sometimes contraindicated for this reason. The gait pattern can also differ between patients with dystonia and spastic hemiplegia.

Two years after the PTB orthosis had been applied the patient was still satisfied with the orthosis and shoes and did not opt for surgery, despite the disadvantages of the orthosis, such as its weight, bulkiness, appearance, and the risk of conflict (between the PTB orthosis and the malleolus), which made it impossible for him to walk barefoot.

Table I. *Patient's abilities with and without the orthotic fitting*

| | Barefoot, without assistance | With orthotic fitting |
|---|---|---|
| Upright position | Very difficult | Unrestricted |
| Indoor ambulation | Restricted and not used | Unrestricted |
| Outdoor ambulation | Impossible | Possible |
| Walking perimeter on flat ground, m | ≤20 | ≤500 |
| Stair climbing | Impossible | Possible |
| FAC | 4 | 6 |
| Motor FIM | 6 | 12 |

FAC: Functional Ambulation Categories; FIM: Functional Independence Measure.

Table II. *Temporo-spatial gait parameters of gait recorded with the GAITRite® system and body weight distribution in each lower limb recorded with 2 force-plates*

| | Barefoot | | With orthotic fitting | |
|---|---|---|---|---|
| Speed, m/sec | 0.98 | | 0.81 | |
| Cadence, steps/min | 253 | | 117 | |
| | Left Mean (SD) | Right Mean (SD) | Left Mean (SD) | Right Mean (SD) |
| Step length, cm | 32 (3.91) | 15 (4.43) | 46 (2.33) | 37 (4.95) |
| Base support, cm | 18 (2.56) | 18 (1.29) | 23 (1.59) | 23 (2.04) |
| Single support, sec | 0.17 (0.01) | 0.21 (0.01) | 0.36 (0.03) | 0.43 (0.02) |
| Body weight distribution, % | 8.5 | 91.5 | 27.6 | 72.4 |

SD: standard deviation.

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