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Chapter 6
Use and Effectiveness of Orthotics in Hyperpronated dancers

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Use and effectiveness of orthotics in hyperpronated dancers.
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Abstract 
Hyperpronation is a common foot problem in dancers. The aim of this study was to investigate 
the usage and effectiveness of orthotics in the management of symptomatic hyperpronation 
among dancers. A prospective cohort study of all dancer-patients in the investigators' practice 
who were prescribed orthotics for new symptoms related to hyperpronation between July 2008 
and January 2009 was conducted. In this group, the longitudinal medial arch angle of the foot 
was measured by the Foot Build Registration System (FBRS), both barefoot and while wearing 
the orthotics. In addition, patients filled out questionnaires addressing perceived effectiveness 
of the orthotics for pain reduction and dance ability, among other items. A second retrospective 
study was conducted in order to obtain longitudinal data regarding dancers’ compliance with, 
and subjective evaluation of, wearing orthotics over the preceding 6 years. Among participating 
dancers who met criteria for the prospective (N = 24) or retrospective (N = 81) aspects of the 
study (total N = 105), 67% wore orthotics at the time of follow-up. The average compliance 
in usage was 6.0 (± 1.5 ) days per week and 7.5 (± 3) hours per day. The average rate of 
satisfaction was 67.9 (± 26.5), average degree of relief in symptoms was 58.3 (± 28.3), and 
self-reported degree of improvement in dance ability was 45.7 (± 27.9) on a 100 mm Visual 
Analogue Scale (VAS). There was a significant decrease in pain from the day of orthotics 
prescription to follow-up (25.9, or 18.9 mm decrease on the VAS, CI 6.6-30.9, p = 0.005) in 
the prospective group (N = 24). Orthotics were found to decrease the medial longitudinal arch 
angle significantly during static stance with the orthotic in place (CI 0.08-1.65, p = 0.03). It is 
concluded that the dancers in this study demonstrated a high rate of compliance in obtaining 
and wearing their orthotics and experienced a significant decrease in pain.
Introduction
Pronation of the foot is one of the triplanar movements made at the subtalar joint and occurs when initial contact is made by the forefoot with the ground, enabling shock absorption.\textsuperscript{1,2} Excessive pronation, or hyperpronation, is thought to be a common foot problem; it affects about 20\% of people worldwide\textsuperscript{3} and is found in approximately 30\% of dancers.\textsuperscript{4} The etiology of hyperpronation (commonly called “rolling in” among dancers) is multifactorial. It is often the result of a compensatory mechanism seen in structural deformities\textsuperscript{5} such as tibial varum and varus forefoot or valgus rearfoot.\textsuperscript{1,6} In dancers, hyperpronation is thought to play a role in, and be exacerbated by, compensatory strategies to achieve the classical ballet “turned-out” (externally rotated) aesthetic when limited external rotation exists at the hips. A common pattern of compensation in dancers who “force” their turn out involves: 1. hyperlordosing the lumbar spine while slightly flexing at the knees, 2. internally rotating at the tibia while rotating the toes outward, resulting in hyperpronation at the subtalar joint and gripping of the floor with the toes to hold the position, and 3. hyperextending the knees (see figure 1).

Figure 1 Classical dancer performing a demi-plié: A. Correct alignment; B. Due to insufficient external rotation at the hip, this dancer incorrectly grips the floor with her toes and hyperpronates at the subtalar joint bilaterally.
It is unclear whether forced turn out during dance activity causes permanent hyperpronation over time in those previously without it, worsens pre-existing hyperpronation in individuals born with it, or whether hyperpronation remains situational to the dance activity. Nevertheless, it is implicated in altered lower extremity biomechanics at the distal foot, knee, hip, and pelvis,\textsuperscript{1,2,7,8} which is thought to predispose to injury, particularly with repetitive tasks such as forced turn-out.\textsuperscript{1,2,7,8-12} Hyperpronation has been associated with the development of conditions such as patellofemoral pain syndrome (PFPS), retropatellar chondropathy (RPCP),\textsuperscript{6,13-16} flexor hallucis longus tendonitis,\textsuperscript{7} Achilles tendonitis,\textsuperscript{1,7,9,17,18} hallux valgus, and bunions,\textsuperscript{2} all of which are among the most common injuries in dancers.\textsuperscript{6,19} In addition, excessive pronation stretches the supporting ligaments and tendons of the plantar and medial aspects of the foot and ankle, which jeopardizes the maintenance of the medial arch.\textsuperscript{2} Hyperpronation may also lead to difficulty during re-supination of the foot to go on pointe.\textsuperscript{7} At the investigators’ clinic when a dancer-patient presents with symptoms related to hyperpronation, orthotics are regularly prescribed for conservative management. These orthotics are rigid arch supports that span three-quarters of the length of the foot and are custom made by a trusted orthopaedic technologist who uses a non-weightbearing foam mold and a weightbearing blueprint (see figure 2). Most orthotics contain a metatarsal pad, unless the dancer is younger than 18 years of age. The orthotics are meant to be worn in street shoes only for relatively static activities (standing and walking) but not dynamic dance activity. There is currently no device that can fit into ballet slippers, soft shank jazz shoes, or pointe shoes to control hyperpronation while still allowing the dancer to have the fine mid- and forefoot articulation that is required for dancing. Orthotics have been shown to decrease tibial internal rotation,\textsuperscript{20} the calcaneal eversion angle,\textsuperscript{21,22} and navicular drop,\textsuperscript{23} which are all associated with hyperpronation. They appear to reduce complaints in patients with PFPS\textsuperscript{20,24-30} by reducing maximum pronation and calcaneal eversion and decreasing maximum internal tibial rotation acceleration and velocity.\textsuperscript{31-33} Orthotics have additionally been shown to decrease the risk of developing overuse injuries such as medial tibial stress syndrome (MTSS) and stress fractures.\textsuperscript{34,35} However, they are costly and time consuming to obtain (which may pose challenges to dancers, who are often limited by income), and it is unclear whether these benefits translate to the dancer-patient, who is unable to wear the orthotics during the very
activity in which hyperpronation is thought to be exacerbated. Despite the widespread prescription of orthotics, there is no evidence regarding compliance with wear or effectiveness in dancers with symptoms related to hyperpronation. Therefore, the purposes of this study were to evaluate dancers’ compliance with orthotics when prescribed for symptomatic hyperpronation and to investigate whether wearing rigid three-quarter orthotics during nondance activity reduces symptoms during dance activity.

Materials and Methods
This study took place at the Medical Centre for Dancers and Musicians (MCDM), The Hague, The Netherlands between July 2008 and January 2009. All study protocols and questionnaires were approved by the Medisch Ethische Toets Commissie Zuidwest Holland. The study participants were informed of the study protocol and provided written consent prior to participation, which

<table>
<thead>
<tr>
<th>Variable</th>
<th>Retrospective Group (N = 81)</th>
<th>Prospective Group (N = 24)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at consult MCDM, M (SD)</td>
<td>31.2 (12.9)</td>
<td>24.8 (15.0)</td>
</tr>
<tr>
<td>Female, N (%)</td>
<td>69 (85.2)</td>
<td>22 (91.7)</td>
</tr>
<tr>
<td>Male, N (%)</td>
<td>12 (14.8)</td>
<td>2 (8.3)</td>
</tr>
<tr>
<td>Degree of hyperpronation, N (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Mild (+)</td>
<td>26 (32.1)</td>
<td>6 (25)</td>
</tr>
<tr>
<td>• Moderate (+++)</td>
<td>23 (28.4)</td>
<td>15 (62.5)</td>
</tr>
<tr>
<td>• Severe (+++)</td>
<td>8 (9.9)</td>
<td>3 (12.5)</td>
</tr>
<tr>
<td>• Unknown</td>
<td>24 (29.6)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Level of dancer, N (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Professional</td>
<td>28 (34.6)</td>
<td>1 (4.2)</td>
</tr>
<tr>
<td>• Teacher</td>
<td>5 (6.2)</td>
<td>2 (8.3)</td>
</tr>
<tr>
<td>• Student</td>
<td>28 (34.6)</td>
<td>10 (41.7)</td>
</tr>
<tr>
<td>• Amateur</td>
<td>20 (24.7)</td>
<td>11 (45.8)</td>
</tr>
</tbody>
</table>

* It may be argued that 3 hours does not suffice for the definition of a “dancer”; however, this clinic treats dancers of all backgrounds, levels, and intensities. Three hours is used as a “cut off” to be seen in the clinic and is useful for capturing the spectrum of amateur dancers, former dancers who may have previously danced more hours, injured dancers who are currently not dancing to their fullest, as well as the range from academy students to professional dancers. This study was designed to be generalizable to the dancing patient population at large, rather than one specific or elite group. However, the investigators encourage further research into specific subgroups of dancers.
was voluntary. If requested, the participants received compensation for their travel costs. All questionnaires were available in Dutch and English.

Prospective Study
Dancer-patients who were seen at the MCDM during the study period and prescribed orthotics for symptoms related to hyperpronation, were invited to participate in the prospective study regarding compliance rate and effectiveness of orthotics. Dancers had to meet the following inclusion criteria: engagement in 3 or more hours of dance activity per week,* a chief complaint thought to be related to foot hyperpronation, and receipt of a prescription for custom made orthotics. Dancers who were found to have incidental hyperpronation on physical exam (that was not thought to be related to the chief complaint) were excluded. All dance styles and ages and both genders were included (Table 1). By the time of their formal entry into the study, all patients had been given a physical exam by the senior investigator, who is a performing arts medicine specialist. Eligible dancers were asked to fill out a five-item questionnaire regarding their understanding of the prescription, their motivation for obtaining and wearing the orthotics, their confidence in the orthotics’ effectiveness, and their pain. Continuous variables were measured by a 100 mm Visual Analog Scale (VAS), the upper and lower boundaries of which were descriptive (i.e., “Not confident at all” and “Completely confident”). Patients indicated their answers with an X on the line. The dancers were instructed to obtain their orthotics from a single manufacturer to minimize variability in type and to take advantage of the fact that durability of orthotics has historically been obtained from this vendor. Dancers were invited to participate in the second phase of the study (posttreatment follow-up) if they met the criteria mentioned above and had worn the orthotics for a minimum of 6 weeks. After a minimum period of 8 weeks following their first visit, all patients were invited to return to the clinic for measurement of the medial longitudinal arch angle of the foot and to fill out a 26-item follow-up questionnaire. This questionnaire inquired about demographic information, dancers’ compliance in obtaining and wearing the orthotics, their experience and satisfaction with the orthotics, the financial costs of orthotics, and current level of pain as related to the chief complaint. As in the first questionnaire, continuous variables, such as satisfaction rate and pain, were measured using a VAS scale.

Measuring Pain Reduction: In both questionnaires, the dancers in the prospective group were asked to give their current estimation of pain level of the chief complaint thought to be related to hyperpronation by placing an X on the VAS scale. The pain reduction percentage was calculated by dividing the difference in pain pre- and post-treatment by the pre-treatment pain intensity and multiplying by 100.36
Estimating the Severity of Hyperpronation: The degree of hyperpronation was graded based on a scale that the senior investigator has been using clinically for over 20 years. In this exam, hyperpronation is assessed by squatting in front of the barefoot patient and observing “rolling in” of the feet and the valgus position of the ankle in a relaxed stance after maximal inversion and eversion of the ankles. Then the hallux is extended (dorsiflexed) at the MTP joint while the other digits remain on the floor. This maneuver, often called the “Hübscher maneuver” or “Jack test,” causes inversion of the foot back to neutral positioning. The visual estimation of the amount of “roll in” while the dancer is at rest, plus the degree of correction needed to obtain neutral position via hallux extension, are then used to grade the severity of hyperpronation from + to +++ (mild to severe). Each foot is examined separately. Thus, a patient with +/++ in the chart implies a right foot with a mild degree of hyperpronation and the left foot with moderate hyperpronation. While each foot is examined separately, the dancer is classified overall as a mild, moderate, or severe hyperpronator based on the more severe foot.

Measuring the Effect of Orthotics on the Medial Longitudinal Arch Angle: In the prospective study, the Foot Build Registration System (FBRS) was used to investigate and document changes in the medial longitudinal arch angle (angle between hallux, navicular bone and medial calcaneus) due to orthotics wear in the posttreatment follow-up group (Fig. 3). This system consists of a round Trespa® plate (79 x 79 cm), which encloses a safety glass plate (49 x 49 cm) and is surrounded by a steel frame. A digital camera can be attached to the FBRS so that images can be made from the anterior, posterior, lateral, and medial view of the foot. The measurements were made with the dancer standing in a relaxed first position with one foot on the platform and the other on a step 30 cm above the platform.

Retrospective Chart Review
At the time of chart review, the readily available (last 6 years) archive of the clinic’s patient data filing system stored a total of 2,427 dancers’ charts. These were all non-selectively and alphabetically explored to identify patients who were diagnosed with complaints related to hyperpronation of the feet and prescribed orthotics. This review did not include the charts of patients in the prospective group. Patients with available email addresses were sent an electronic questionnaire identical to the 26-item follow-up questionnaire used in clinic by the prospective study patients. Up to three attempts were made to contact each individual patient. The dancers had to meet the same inclusion criteria as those in the prospective study.

Statistical Analysis
Results from the prospective and retrospective groups were analyzed separately to determine
any statistically significant differences between the groups. When present, such differences were recorded. In the absence of significant differences, results of both groups were pooled for analysis. Statistical analysis was performed using SPSS (version 17.0) statistical software (Chicago, Illinois, USA). For continuous variables, the Students’ t-test was used for independent samples or two-way ANOVA to calculate the statistically different degrees of hyperpronation in the prospective and retrospective groups. The Fisher’s Exact Test was used for dichotomous variables. To analyze pain reduction, we used the Students’ t-test for paired samples, with the level of significance set at \( p < 0.05 \). On the 100 mm VAS scale, patient satisfaction was defined as greater than or equal to 60 mm, and significant relief of complaints during dance activity at 30 mm or more. A decrease in pain of 15 mm or more on the VAS scale was considered significant. “Regular” wear of orthotics was set at 5 days or more per week, or 6 hours or more per day on the days of usage for 2 or more days per week.

Results

Participation Prospective Study

In the prospective study, 76 patients participated in the pre-treatment physical exam and questionnaire. Of these, four patients subsequently cancelled their cooperation with the study, 13 patients did not meet the criterion of wearing their orthotics for at least 6 weeks, 33 did not respond to our contact, and 2 patients had provided invalid contact information. Hence, a total of 24 patients (2 males, 22 females; mean age = 25.0 ± 15 years; range 10 to 68 years) met the criteria for post-treatment analysis and returned for the follow-up exam and 26-item questionnaire (32%).
Retrospective Study
In the retrospective chart review, 739 of 2,427 patients met the inclusion criteria (30%), and 322 of these patients had valid email addresses. Of the 322 patients, 16 had stopped dancing, and 224 did not respond to our emails. A total of 81 patients (12 males, 69 females; mean age = 31.0 ± 13 years; range 14 to 65 years) were included in the retrospective part of this study (25%). Demographic information is displayed in Table 1.

Table 2. Dancers’ Compliance with Orthotic Prescription

<table>
<thead>
<tr>
<th>Usage pattern</th>
<th>Dancers who obtained orthotics, N (%)</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obtained orthotics, N (%)</td>
<td>91</td>
<td>(86.7)</td>
</tr>
<tr>
<td>Wears orthotics regularly,* N (%)</td>
<td>47</td>
<td>(51.6)</td>
</tr>
<tr>
<td>Initially obtained orthotics but stopped wearing them, N (%)</td>
<td>30</td>
<td>(33.0)</td>
</tr>
<tr>
<td>Number of hours per day of wear, M (SD)</td>
<td>7.5</td>
<td>(3.0)</td>
</tr>
<tr>
<td>Number of days per week of wear, M (SD)</td>
<td>6</td>
<td>(1.5)</td>
</tr>
<tr>
<td>Percentage pain reduction, M (SD)</td>
<td>25.9</td>
<td>(25.0)</td>
</tr>
</tbody>
</table>

* ≥ 5 days per week or ≥ 6 hours per day and ≥ 2 days per week.

Table 3. Dancers’ Reasons for Compliance and Noncompliance with Orthotics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Dancers who obtained orthotics (N = 91)</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reason for wearing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Feels more stable</td>
<td>32</td>
<td>32.5%</td>
</tr>
<tr>
<td>• Doctor told me to</td>
<td>29</td>
<td>31.9%</td>
</tr>
<tr>
<td>• Less pain</td>
<td>28</td>
<td>30.8%</td>
</tr>
<tr>
<td>Reason for NOT wearing*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Pain went away</td>
<td>13</td>
<td>33.3%</td>
</tr>
<tr>
<td>• They hurt</td>
<td>9</td>
<td>23.1%</td>
</tr>
<tr>
<td>• Don’t fit in all shoes</td>
<td>9</td>
<td>23.1%</td>
</tr>
<tr>
<td>• Too cumbersome</td>
<td>3</td>
<td>7.7%</td>
</tr>
<tr>
<td>• Don’t think they’ll work</td>
<td>2</td>
<td>5.1%</td>
</tr>
<tr>
<td>• Forget to put them in shoes</td>
<td>1</td>
<td>2.6%</td>
</tr>
<tr>
<td>• No reason</td>
<td>2</td>
<td>5.1%</td>
</tr>
</tbody>
</table>

*Of the 39 dancers who had not worn the orthotics regularly or stopped wearing them completely.
Degree of Hyperpronation
Of the 105 patients (210 feet) who participated in the 26-item questionnaire regarding compliance and satisfaction (81 from the retrospective group and 24 from the prospective group), 81 patients’ degree of hyperpronation had been noted in their chart (162 feet documented, 77%). Patients were separated into mild, moderate, and severe groups based on their more severely hyperpronated foot. According to this definition, 39.5% (N = 32) of patients were classified as mild (+), 46.9% (N = 38) as moderate (++), and 13.6% (N = 11) as severe (+++) hyperpronators. There was no significant difference between the degree of hyperpronation in the prospective and retrospective groups ($X^2 = 3.61, p = 0.16$).

Compliance
Of the 105 dancers included in the study, 91 dancers (87%) obtained the prescribed orthotics. All (100%) of the 24 patients in the prospective group obtained the orthotics, as did 83% (N = 67) in the retrospective group. At a mean follow-up period of 36.6 months (± 39.6 months), 61 of 91 dancers (67%) still wore the orthotics at the time of inquiry. Among current wearers, the average time spent wearing the orthotics was 6 days per week (± 1.5 days) and 7.5 hours per day (± 3 hours). Forty-seven dancers wore their orthotics regularly at time of follow-up (52%), as per the definition of regular wear in Methods. Among all dancers who purchased orthotics, 52 had worn them regularly (57.1%) and 39 had worn them every day (42.9%) during the time they wore the orthotics the most (Table 2). There were no significant differences found in compliance with wear between the prospective and retrospective groups in days per week (CI -0.02–1.55, $p = 0.06$) and hours per day (CI -0.92–2.40, $p = 0.38$). On one-way ANOVA, there were no differences in compliance with wear between the different degrees of hyperpronation in days per week ($F = 92, p = 0.41$) and hours per day ($F = 0.46, p = 0.63$), as shown in Table 3.

Dancers stated that the main reasons for wearing the orthotics were that they “felt more stable” (N = 32, 32.5%), “because the doctor told [them] to” (N = 29, 31.9%), and because they had “less pain when [they] wore them” (N = 28, 30.8%). Among dancers who had not worn the orthotics regularly (N = 9) or stopped wearing them completely (N = 30: total N = 39, 42.9%), their reasons for infrequent use or cessation were: “My pain went away” (N = 13, 33.3%), “They hurt” (N = 9, 23.1%), “They don’t fit in all the shoes I want to wear” (N = 9, 23.1%), “They are too cumbersome” (N = 3, 7.7%), “I don’t think they work” (N = 2, 5.1%), and “I forget to put them in my shoes” (N = 1, 2.6%). Two patients (5.1%) gave no reason (Table 3).

Between the prospective and retrospective groups the reasons for wearing the orthotics were equally distributed ($X^2 = 4.00, p = 0.26$). The given reasons for wearing the orthotics were not correlated with the degree of hyperpronation ($X^2 = 6.41, p = 0.38$). There were no differences
in reasons for cessation in wearing the orthotics between the prospective and retrospective groups ($X^2 = 2.18, p = 0.70$), and these reasons also did not correlate with the different degrees of hyperpronation ($X^2 = 10.24, p = 0.25$).

**Decrease in Pain**
There was a significant decrease in pain from the day of orthotics prescription to follow-up (25.9%, or 18.9 mm decrease on the VAS, CI 6.6–30.9, $p = 0.005$) in patients of the prospective study group. There was no significant relationship found between the decrease in pain and the degree of hyperpronation ($F = 1.70, p = 0.20$).

**Satisfaction, Relief, and Improvement in Dance**
The average satisfaction in all dancers who obtained the orthotics was 67.9 mm (± 26.5) on the 100 mm VAS, which was significant according to the definition of significance set prior to testing at 60 mm or more. The mean satisfaction was 61.2 mm (± 27.0) for mild hyperpronators, 72.5 mm (± 22.6) for moderate, and 67.2 mm (± 34.2) for severe hyperpronators. The mean reduction in symptoms was 58.3 mm (± 28.3), which was considered to be significant according to our definition of 30 mm or more. Per group, the average report of relief was 57.2 mm (± 30.2), 55.5 mm (± 26.5), and 62.3 mm (± 31.7) for mild, moderate, and severe hyperpronators, respectively. Among all dancers, improvement in ability to dance without symptoms was 45.7 mm (± 27.9), considered to be significant according to our prior set definition of 15 mm or more. Per group, this improvement was 42.8 mm (± 41.8), 45.4 mm (± 26.5), and 54.1 mm (± 33.8) for mild, moderate, and severe hyperpronators, respectively. Dancers with a moderate or high degree of hyperpronation reported the most satisfaction, relief, and improvement in ability to dance without symptoms, although not significantly ($F = 1.27, p = 0.28; F = 0.23, p = 0.80; and F = 0.75, p = 0.47$ for satisfaction, relief, and symptom-free dancing, respectively). There were also no differences in reported subjective effectiveness between the prospective and retrospective study groups (CI -15.00–12.20, $p = 0.84$ for satisfaction, CI -24.82–1.99, $p = 0.09$ for relief, and CI -14.01–12.90, $p = 0.94$ for improvement in dance).

**Effect of Orthotics on the Medial Longitudinal Arch Angle**
Of the 24 patients in the prospective study’s follow-up group, 16 patients (32 feet) were measured with the FBRs (Foot Build Registration System). Six feet were excluded due to insufficient camera images; therefore, 26 feet were included for data-analysis. The mean medial angle with the dancer standing barefoot on the surface was 142.2° (± 9.4°) and 139.6° (± 9.4°) when standing on the surface while wearing orthotics. The mean decrease of the
medial angle was 0.9° (± 1.9°), which was statistically significant (CI 0.08–1.65, p = 0.03).

Discussion
Hyperpronation of the foot is a common finding upon physical exam, and it is thought to be related to, if not causative of, certain somatic complaints and injuries. Despite lack of evidence regarding their effectiveness, orthotics are widely prescribed for the conservative management of foot hyperpronation among dancers and non-dancers alike. This is the first study to examine compliance with wear and perceived effectiveness of orthotics in dancer-patients seen at a high-volume center for performing arts medicine.

Compliance
Dancers showed a high rate of compliance in acquisition and long-term use of prescribed orthotics. Sixty-seven percent of patients still wore their orthotics at the time of follow-up, including those who had had the orthotics for up to 6 years. Seventyseven percent of these patients wore the orthotics regularly. This rate of compliance is likely elevated by self-selection for study participation of more compliant dancers, or those who had a good outcome. The investigators would have liked a higher response rate and fewer patients lost to follow-up for greater accuracy. However, the rate of acquisition may also be higher in this study than what would be expected in other countries because dancers living in The Netherlands are insured, and orthotics are partially covered. The cost of orthotics is around 170 euros. The reasons identified for dancers’ compliance with orthotics acquisition and wear were interesting. Across multiple fields of medicine, patients’ compliance with doctors’ recommendations has been studied, including health care seeking behavior among dancers. In this study, the most popular reason (32%) for obtaining orthotics was “Because the doctor said so.” This emphasizes the physician’s role in the doctor-dancer relationship. It is important that doctors spend time explaining hyperpronation and its somatic sequelae to dancers, as well as how orthotics and exercises may help to improve or prevent complaints in the future. Increased patient education may mean more compliance among dancer-patients. In particular, dancers may find it useful to know that orthotics appear to decrease the medial longitudinal arch angle and degree of hyperpronation according to the FBRS, as well as decrease pain when worn compliantly for approximately 6 weeks. Regarding dancers’ reasons for stopping their wear of orthotics or for not wearing them at all, the most popular reason cited (33%) was that the dancer’s pain went away. This response was not pursued further in this study, but it may indicate successful therapy in those dancers who wore their orthotics and then stopped. The relationship between orthotics usage and pain should be further evaluated and clarified.
Other reasons dancers gave for stopping their use of orthotics were "They hurt" and "I don’t think they work." Discomfort is, unfortunately, common in the first 2 to 4 weeks of wearing custom shoe inserts. Orthotics are meant for long-term wear, and treatment should not be considered a failure because of discomfort early on. It is important for the prescribing physician to educate the dancer about this ahead of time; that the discomfort is only temporary when, and if, it occurs. Nevertheless, severe discomfort should prompt follow-up with the physician to ensure that the orthotics are moulded properly to the patient’s feet.

The proper duration of orthotics wear is not yet clear. In the clinical setting, orthotics are typically prescribed for a minimum of 3 to 6 months. Anecdotally, in the investigators’ clinic most dancers do not like the idea of having to wear the orthotics indefinitely. We therefore instruct each patient to wear the orthotics for a minimum of 3 to 6 months and then stop, provided that the chief complaint has improved or disappeared. The dancers are advised to start wearing them again if symptoms recur. If complaints persist despite regular wear of the orthotics for 3 to 6 months, the dancer is usually advised to stop wearing them, unless symptoms are worse without them. Regular clinical follow-up with dancers after they have been prescribed orthotics is important to re-evaluate symptom resolution.

**Effectiveness**

Based on the significant rate of satisfaction with orthotics therapy (67.9%), the reduction of somatic complaints (58.3%) and the improvement of perceived ability to dance without symptoms (45.7%), it can be assumed that orthotics therapy is effective, even when worn only in street shoes. There was a general trend in the data to a lower rate of effectiveness among mild pronators compared to moderate or severe, but this did not achieve significance. Decreased symptoms during dance activity due to wearing orthotics during non-dance activity may suggest a translational component to regular orthotics wear, such as muscle memory for correct lower extremity alignment, or more body awareness in the dancer so that she consciously corrects the alignment while wearing unsupportive dance shoes.

The medial longitudinal arch angle of the ankle was significantly decreased with the orthotics (139.6° vs. 140.2°, mean decrease 0.9° ± 1.9°), which may have contributed to the decreased pain and symptoms during dance reported by the dancers in this study. Orthotics will not “cure” hyperpronation; they are intended to correct malalignment. Realignment may, in turn, relieve stress on the foot-ankle complex, redistribute forces more equally up the kinetic chain, and relieve symptoms. Conscious realignment and avoidance of compensatory strategies, especially when performing the classical ballet positions, is important to incorporate into correct dance technique.
Limitations
The major limitation of this study was its poor response rate. Many dancers who were considered for the prospective group were not compliant with 6 weeks wear of orthotics. The majority of the follow-up (drop-out) issues in the retrospective study were due to invalid or absent contact information, as well as the potentially long time lapse between consultation and request for participation (up to 6 years).
Although it is generally true that prospective data have a higher level of reliability than retrospective data, we decided not to draw this distinction. Because there were no significant differences between the two study groups in compliance, degree of hyperpronation, or subjective effectiveness, these data were pooled. We were unable to pool the data regarding decrement in pain or change in the medial longitudinal angle, because these had only been measured in the prospective (smaller) group, which may affect the generalizability of these results.
The study results pertain only to rigid, three-quarter length, custom made orthotics. The effectiveness of other orthotics cannot be extrapolated.
Socioeconomic status was not included in our analysis of compliance due largely to the fact that insurance is mandated in The Netherlands.
Finally, only the decrease in medial longitudinal angle in stance position was measured, rather than during dynamic activities such as walking.

Conclusion
Symptomatic hyperpronation is common among dancers presenting to the physician’s office, and orthotics are frequently prescribed for conservative management. Dancers in this study showed a high rate of compliance in obtaining and wearing these devices. The orthotics were associated with decreased pain and improved ability to dance without symptoms. However, because of the small number in the prospective study group, further research is needed to investigate the decrease in pain and medial ankle angle due to orthotics in a larger study group. Dancers with a moderate or high degree of hyperpronation appeared to experience the most relief with regular orthotics wear.

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References

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