Lateral ankle sprain alters postural control in bipedal stance – part 1: restoration over the 30 days following the injury

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The time evolution of the postural behavior of 23 lateral ankle sprain patients (degrees I and II) were evaluated 14 h and 10 and 30 days on average after their injury and compared with those of 30 age-matched healthy individuals. The patients were tested with separate measurements of the reaction forces under each limb to highlight the possible compensatory mechanisms between the sound and the injured legs. Their postural behavior in bipedal stance was characterised by a weight-bearing asymmetry with more weight on the sound leg and an asymmetry of the postural stabilisation mechanisms, which are limited and perturbed under the injured leg. Pain appears to be the main factor for explaining these postural asymmetries. Despite these asymmetries, the patients were nonetheless more unstable than the individuals constituting the group control. Ten days later, only the weight-bearing asymmetry was still observed whereas 30 days later, the postural behavior was totally normal once again. Lateral ankle sprain perturbs the contribution of the injured leg in postural stabilisation, inducing a larger involvement of the sound leg in the postural stability process. These characteristics are largely reduced 10 days after the injury.

Lateral ankle sprain represents 25% of the sport traumatic injuries (Bar-Dayan & Shemer, 1998). Such injuries result from a fast ankle movement involving a hindfoot moving in varus associated with a tibiotalar plantarflexion. The anterior talofibular ligament is generally the first to be injured. In case of exaggerated movement, the calcaneofibular ligament is generally also injured (for approximately 20% of the patients). With regard to the more severe ankle sprain, it is the posterior talofibular ligament that is also injured. Generally, a recent ankle sprain is characterised by: (1) an increased anterior drawer laxity (Kerkhoffs et al., 2001), (2) a distension during hindfoot varus/valgus movements (Leanderson et al., 1999), (3) a reduction of the proprioceptive sense (Konradsen et al., 1998) and (4) a decrease of the ankle muscle’s maximal force, with largest diminutions for the evertor muscles (Wilkerson et al., 1997; Konradsen et al., 1998).

More than 1 week following the injury, 41% of the patients were not able to maintain a one-legged stance on their injured leg (Leanderson et al., 1999). When available, reported data show that postural stance is largely perturbed sooner rather than later after the injury (Rose et al., 2000; Hertel et al., 2001; Evans et al., 2004). However, the common denominator of all these studies is that they were achieved through one-legged standing protocols. Also, during one-legged stance, other studies involved patients with a chronic instability consecutive to ankle sprain movements (Tropp et al., 1984; Cornwall & Murrell, 1991; Isakov & Mizrahi, 1997). Interestingly, although certain authors have reported larger postural instability consecutive to an old lateral ankle sprain (Cornwall & Murrell, 1991), no postural perturbation was nonetheless observed by others (Tropp et al., 1984; Isakov & Mizrahi, 1997). The significant delay from the injury plus the effect of the rehabilitation methods on postural restoration could explain these discrepancies in results (Goldie et al., 1994). However, analyzing postural maintenance strategies adopted by these patients through a standardised and objective procedure can be helpful to determine accurately the sensorimotor impairment induced by the ankle sprain. If most of the studies involving ankle sprain patients have been undertaken through the one-legged stance protocol, it is because by inducing movements around both the subtalar and talocrural axes, this condition solicits the ankle in a way close to...
what these patients experienced (Cornwall & Murrell, 1991). In contrast, the two-legged stance is less constraining for the ankle joint, whose movements occur principally around the talocrural axis. Although one-legged and two-legged protocols have their own biomechanical and analysis specificities (Burdet & Rougier, 2007), the data extracted from a separate measure of the reaction forces under the sound and injured legs appear in our mind, at least as much suitable as one-legged posture to assess the postural control of ankle sprain patients. In addition, a large number of ankle sprain patients are unable to stand on their single injured leg, preventing an assessment of their postural control organization at this time. Lastly, two-legged standing should be viewed as an easier task to achieve over-repetitive trials, warranting a lack of interaction with fatigue.

Along these lines, our principal objective was to characterise the upright postural stance of ankle sprain patients in the earliest phase following the injury. To this aim, the upright standing ability of patients was evaluated from a few hours after the injury to 1 month later. The initially reported deficiencies should, in our mind, impair postural control. To be more precise, a postural asymmetry and a postural instability are expected. In parallel, the rapid reduction of the clinical deficiencies during the early days is thought to induce a rapid restoration of bipedal standing control, which should come back to normal 30 days after the injury.

Materials and methods
Subject recruitment
Twenty-three patients, who had suffered a lateral ankle sprain, and 30 matched healthy subjects took part in the experiment (Table 1). All the ankle sprain patients were included following their admission at the hospital emergency department and had given informed consent in accordance with the guidelines of the local ethics committee. To be included in the study, the following criteria should be met: (1) adult under 60, (2) first lateral ankle sprain or first repetition more than 1 year after the last sprain, (3) talofibular isolated or combined with calcaneofibular ligament injury, (4) sprain occurring during the last 48 h, (5) degree I or II lateral ankle sprain (Renstrom & Konradsen, 1997), (6) ability to stand up for 40 s in bipedal stance and (7) capacity of understanding instructions. The following exclusion criteria also had to be applied: (1) bilateral ankle sprain, (2) internal ligament ankle sprain, (3) degree III lateral ankle sprain, (4) orthopedic diseases, (5) prior analgesic treatment taken during the last 6 h and (6) pregnancy.

Clinical diagnosis was based on the criteria by Renstrom and Konradsen (1997), which classifies lateral ankle sprains in three levels: Degree I (mild), Degree II (moderate) and Degree III (severe). The perimalleolus oedema was quantified through the circumference difference between the left and right feet. The ability to stand on one leg was evaluated through a three-point scale: 0, possible without pain; 1, possible with pain; 2, impossible. Pain was evaluated through a visual analogical scale of 100 mm in discharge and during upright standing.

Experimental procedure
Postural sway was measured by two rectangular (21 × 32 cm) force platforms (PF02; Equi+, Aix les Bains, France) installed side by side. The signals from the 2 × 4 dynamometric load cells were amplified and converted from the analog to the digital form before being recorded (sample frequency, 64 Hz) on a personal computer. An inert mass of 35 kg, corresponding to the half-body weight of the tested subjects, was placed on each platform to assess its noise characteristics and recorded. The range of plantar center-of-pressure (CoP) movements was inferior along each mediolateral (ML) and anteroposterior (AP) axes to 0.3 mm.

The subjects were asked to stand still barefoot, the eyes masked, each foot placed on one of the two platforms (heels separated by 9 cm, toes out at 30°, arms relaxed freely alongside the body). A sequence corresponded to four trials of 32 s (subjects had to stand up 5 s before the recording), with seated rest periods of 64 s. Patients were evaluated during three randomised sequences: without shoes and socks, with a compression stocking or with an orthosis worn around the sprained ankle foot (with seated rest periods of 5 min between the sequences). Note that only the data from the first barefoot conditions will be presented and discussed in this article. This procedure was repeated three times on the basis of the lateral ankle sprain recovery stages (as described by Renstrom & Konradsen, 1997): (1) at the hospital admission (D0), during the inflammatory stage; (2) at the end of the proliferation stage (D10); (3) during the final reshaping stage, i.e. when the new collagen fibers begin to withstand almost normal stress (D30) (Fig. 1).

Table 1. Demographic, anthropometric and activity data characterising healthy subjects and lateral ankle sprain patients [mean (SD)]

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<td></td>
<td>Women</td>
<td>Men</td>
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<td>Women</td>
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<tr>
<td>Number</td>
<td>11</td>
<td>19</td>
<td></td>
<td>9</td>
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<tr>
<td>Age (years)</td>
<td>27.6 (8.1)</td>
<td>31.3 (9.0)</td>
<td>P&lt;0.22</td>
<td>28.1 (8.0)</td>
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<tr>
<td>Height (cm)</td>
<td>166.7 (5.1)</td>
<td>180.1 (5.8)</td>
<td>P&lt;0.19</td>
<td>167.0 (6.5)</td>
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<tr>
<td>Weight (kg)</td>
<td>63.9 (9.7)</td>
<td>76.5 (10.1)</td>
<td>P&lt;0.32</td>
<td>65.1 (9.1)</td>
</tr>
<tr>
<td>Foot length (cm)</td>
<td>22.1 (3.5)</td>
<td>25.8 (3.7)</td>
<td>P&lt;0.12</td>
<td>22.0 (3.2)</td>
</tr>
<tr>
<td>Dominant foot (R/L/?)</td>
<td>7R/1L/?</td>
<td>15R/1L/3?</td>
<td></td>
<td>6R/1L/3?</td>
</tr>
<tr>
<td>Sport activity (Y/N)</td>
<td>9 yes/2 no</td>
<td>16 yes/3 no</td>
<td></td>
<td>6 yes/3 no</td>
</tr>
<tr>
<td>Sport volume (J/week)</td>
<td>2.5 (2.1)</td>
<td>4 (2.0)</td>
<td>P&lt;0.36</td>
<td>2.9 (2.6)</td>
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All differences tested between the two groups were non-significant (P>0.05).
SD, standard deviation; R, right; L, left; Y, yes; N, no.

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It was previously shown that an asymmetric weight bearing could itself change the postural patterns of each leg and postural performance in terms of center-of-gravity (CoG) displacements (Genthon & Rougier, 2005). As a result, both healthy individuals and ankle sprain patients were tested in an asymmetric stance in order to neutralise the postural effects due to the weight-bearing asymmetry. Patients with lateral ankle sprain were thus instructed to adopt a spontaneous stance whereas healthy individuals were in second hand instructed to adopt a precise body weight distribution (previously determined on patients at D0 and consisting approximately in applying 56% of body weight applied on one leg). To be more precise, after performing a preliminary training trial during which an oral feedback on body weight distribution on both legs was given, the healthy subjects had to perform four recorded trials with that distribution. If necessary, another feedback was given between the trials to avoid any possible interaction with the postural evaluation.

Signal processing
The reaction forces under both supports were simultaneously recorded on a personal computer from four vertical dynamometric load cells placed under both platforms (range of measurements 0–150 daN). The signals issued from the eight load cells were amplified and converted from the analog to the digital form through a 14-bits acquisition card and then recorded with a 64 Hz frequency (without any filtering).

The resultant center-of-pressure (CoPRes) displacements were calculated along each ML and AP axes from the left and right CoP displacements using the following formula (Winter, 1995):

$$\text{CoP}_{\text{Res}} = \frac{\text{CoP}_{lf} \times R_{lf}}{R_{lf} + R_{rf}} + \frac{\text{CoP}_{rf} \times R_{rf}}{R_{lf} + R_{rf}}$$

where CoP$_{lf}$, CoP$_{rf}$, R$_{lf}$, R$_{rf}$ are the CoP coordinates and the vertical reaction forces under the left and right feet, respectively.

Extracted parameters
Because CoP$_{\text{Res}}$ trajectories along the ML and AP axes are controlled by specific muscular groups (Winter et al., 1996; Rougier, 2007), these trajectories were separately analyzed along these orthogonal axes. The left and right CoP trajectories, due to the feet position (tilted to ±15°, from the ML–AP referential framework, Fig. 2), were characterised on a planar basis in order to describe the reaction forces occurring under each leg, independent of the ML–AP referential framework.

The body weight distribution on both legs was calculated. The temporal and spatial characteristics of the different trajectories were evaluated through a frequency analysis. Beforehand, the CoP trajectories (left and right feet and resultant) were converted in the frequency domain through a fast Fourier transform in order to obtain the amplitude distribution as a function of the frequency. The frequency spectra were then characterised by two parameters calculated on a 0–3 Hz frequency bandwidth: the root mean square (RMS) and the mean power frequency (MPF).

In addition, in order to characterise the shape of the CoP trajectories under both feet, a lengthening ratio (LR) was computed. To this aim, plantar CoP trajectories were decom-
posed along the longitudinal and lateral feet axes and characterized through their respective RMS. The LR was then computed as follows (Fig. 2):

\[ LR = \frac{RMS_{\text{longitudinal}} - RMS_{\text{lateral}}}{RMS_{\text{longitudinal}} + RMS_{\text{lateral}}} \]

By definition, this LR ratio is ranged between −1 and 1. A value of 0 expresses similar CoP magnitudes along both longitudinal and lateral foot axes, whereas values close to 1 or −1 indicate that the displacements occur predominantly along the longitudinal or lateral axis of the foot, respectively.

Statistical analysis
Normal distributions were analyzed for all the calculated parameters through the Kolmogorov–Smirnov test. Differences between normal and tested distributions (RMS and MPF for all trajectories) being not statistically significant (P>0.05), parameters characterising plantar CoP trajectories were thus compared using three-factor (group, foot, experimental condition) analyses of variances (ANOVA). Parameters characterising the resultant CoP trajectories were compared using a three-factor (group, axis, experimental condition) ANOVA. A Newman–Keuls comparison test was then used as post hoc analysis. The possible relationships between clinical and experimental quantitative variables were analyzed using Pearson correlation tests. If a difference between clinical and experimental quantitative variables was thus compared using three-factor (group, foot, experimental condition) ANOVA. A Newman–Keuls comparison test was then used as post hoc analysis.

Results
Clinical characteristics of ankle sprain patients

Twelve patients with degree I ankle sprains and 11 with degree II ankle sprains were included in this study. Even though other grading is available, the present one offers the advantage to be currently used throughout the hospital emergency departments, at least in France. Approximately 15h following the injury, they were characterised by moderate oedema and pain in discharge and in upright stance (Table 2).

Only three patients were able to maintain one-leg stance on their injured leg without pain. Pain, oedema and the ability to stand on one leg changed during the first 10 days following injury (P<0.001), while these scores remained unchanged from day 10 to day 30 (P>0.05, Table 2).

Postural behavior of ankle sprain patients at D0

Plantar CoP trajectories

Weight-bearing asymmetry. Fourteen hours following sprain, patients carried 44% (± 7) of their body weight on their injured leg (mean ± SD). The healthy subjects were thus required to voluntarily distribute their body weight in similar proportions.

Amplitude (RMS). A foot effect [F (1570) = 18.89, P<0.001] and an interaction between group and foot [F (3570) = 5.09, P<0.01, Fig. 3 and Table 3] were reported. In patients, CoP mean amplitude under their injured foot was reduced in comparison with their healthy leg (P<0.001) and in comparison with the control group (P<0.01).

Frequency (MPF). A foot effect [F (1570) = 5.14, P<0.05] without interaction between foot and group [F (3570) = 2.09, P>0.05] was reported. The un laden foot CoP trajectories are characterised by a lessened MPF than those of the loaded foot, for both the patient and the control groups (Table 3).

Shape (LR). A group [F (3570) = 2.67, P<0.05] and foot effects [F (1570) = 11.35, P<0.001], with an interaction between foot and group [F (3570) = 4.68, P<0.01, Fig. 3 and Table 3] was reported. CoP trajectories measured under the patients’ injured leg were less organised along the foot longitudinal axis than CoP trajectories measured under their sound leg.
(P < 0.05) and than CoP trajectories measured from the control group (P < 0.001).

**CoP** trajectories

**Amplitude (RMS).** No group [F (3570) = 0.71, P > 0.05] but an axis effect [F (1570) = 423.68, P < 0.001], without interaction between group and axis [F (3570) = 1.73, P > 0.05] was reported. No difference was reported between healthy subjects and ankle sprain patients (Table 4).

**Frequency (MPF).** Group [F (3570) = 8.53, P < 0.001] and axis effects [F (1570) = 17.54, P < 0.001], without interaction between group and axis [F (3570) = 1.10, P > 0.05] were reported. Conversely, no difference between healthy subjects and ankle sprain patients was reported through post hoc analyses (Table 4, P > 0.05).

**Relationships between posturographic data and clinical deficiencies**

The postural characteristics of degree I ankle sprain patients were not different than those observed for degree II patients (P > 0.05). Patients characterised by larger pain in upright stance were also those demonstrating a significant body weight asymmetry (r = −0.36, P < 0.01), larger CoP trajectories under the injured (r = −0.25, P < 0.05) and non-injured legs.
(r = 0.36, P < 0.01) and also larger CoP_res trajectories along both ML (r = 0.36, P < 0.01) and AP axes (r = 0.39, P < 0.001). In parallel, it is worth noting that the more asymmetric patients at D0, the less they were able to maintain one-leg stance (r = −0.36, P < 0.01) and to return to work later (U = 227, P < 0.01). Finally, no statistically significant linear correlation was reported between post-urographic data and perimalleolus oedema.

Recovery of postural characteristics over time

During the 30 days following the injury, the postural characteristics of the patients returned to normal:

(1) The weight-bearing asymmetry was reduced, with an enhancement of the body weight carried on the sprained leg from D0 to D10 (P < 0.001) and from D10 to D30 (P < 0.05). At D30, the body weight distribution of the patients was symmetric [50/50% (± 3)] vs 47/53% (± 6) at D10.

(2) Ten days following the injury, the magnitudes of the two plantar CoP trajectories became symmetric (P < 0.05) due to a CoP magnitude enhancement of the injured support. From D10 to D30, plantar CoP magnitudes remain unchanged (P > 0.05).

(3) During the first 10 days following the injury, the LRs measured under the injured leg were enhanced (P < 0.01), revealing a larger organisation along the foot longitudinal axis for the injured CoP trajectories, as was the case for the healthy subjects. These LR remained unchanged over the next 20 days (P > 0.05).

(4) Resultant CoP trajectory characteristics (magnitude and frequency) were unchanged over the month following the injury (P > 0.05).

Discussion

Upright stance of chronic ankle sprain patients has been largely described few weeks after the injury (Tropp et al., 1984; Cornwall & Murrell, 1991; Isakov & Mizrahi, 1997; Rose et al., 2000; Hertel et al., 2001; Evans et al., 2004). The present study has allowed the upright postural characteristics of ankle sprain patients to be described closer to the injury through a two-legged standing protocol. On the whole, these results are in accordance with all previous studies involving ankle sprain patients but based on one-legged standing protocols (Rose et al., 2000; Hertel et al., 2001; Evans et al., 2004). To be more precise, Rose et al. (2000) were unable to highlight any statistical difference in their two-legged stance protocol across the three visits over the 2 weeks the patients were tested. In contrast, a statistical effect was reported when comparing the number of balance tests completed on the injured leg between visits on days 1 and 3 (i.e., 2 weeks later). Similarly, Hertel et al. (2001) found a decrease of both amplitude and mean velocity under the injured leg over the first 14 days following the injury whereas the data came back to normal 4 weeks later. Lastly, Evans et al. (2004), by comparing the postural sway of both injured and non-injured legs, observed some statistically significant different postural behavior until 21 days after the injury.

Postural behavior of ankle sprain patients are asymmetrical

The major characteristic of the postural behavior of ankle sprain patients is an asymmetry in the frontal plane. This asymmetry involves both orientation (expressed in this study through the mean positions and the mean body weight distribution) and stabilisation (expressed in this study through the RMS and MPF parameters) components of the postural behavior (Massion, 1994).

The first asymmetry, the more obvious one, involves weight bearing with more weight applied to the sound leg. A few hours following the injury, ankle sprain patients applied approximately 56% of their body weight on it. These moderate changes would certainly reduce the strain applied on the collateral lateral ligament, hence, reducing the noceptive inputs and could be considered as an adaptive behavior. Another plausible explanation for reduced loading of the injured limb is an attempt to reduce intra-articular pressure due to effusion in the joint capsule. During full weight-bearing, the fluid is “squeezed” into the anterior and posterior recesses of the talocrural joint capsule and this increased pressure can be quite painful.

Secondly, postural asymmetry of ankle sprain patients can be observed in the dynamical process aimed at stabilising upright stance. The two legs contribution became asymmetric following ankle sprains. This asymmetry involves both the magnitude and the organisation of the plantar ground reaction force regulation. Magnitudes of CoP trajectories measured under the injured leg were reduced and were less organised along the foot longitudinal axis compared with those under the sound one. Because CoP trajectories measured under one leg are mainly controlled along the foot longitudinal axis by ankle flexor/extensor muscles (Okada & Fujiwara, 1983; Gatev et al., 1999; Kim et al., 2003), these results could reveal an alteration of the motor command of the injured leg. Firstly, the magnitude reduction could reveal a lessened muscular recruitment under the injured leg in comparison with the sound one. Secondly, according to the LR, one can observe that the CoP displacements are distributed along the

Genthon et al. (2000) were unable to highlight any statistical difference in their two-legged stance protocol across the three visits over the 2 weeks the patients were tested. In contrast, a statistically significant different postural behavior until 21 days after the injury.
sagittal and transversal foot axes. In patients, the LR measured under injured and sound legs varied greatly, indicating different shapes for the plantar CoP trajectories. Although the LR measured under the sound leg was similar to that found in healthy individuals, indicating an appropriate development of a foot longitudinal pattern, the foot longitudinal excursion of the injured CoP was very restricted. This pattern perturbation on the injured side could reflect an alteration of the selective motor command.

Along these lines, it can be thus suggested that the primary impairment of ankle sprain patients is the limited participation of the injured leg to body stabilisation.

**Postural asymmetries of ankle sprain patients is likely explained by pain**

These deficiencies could be directly explained by some sensorial (Konradsen et al., 1998) and neuromuscular (Wilkinson et al., 1997; Konradsen et al., 1998) impairments classically associated with lateral ankle sprain. Some relationships between unilateral pain and all the postural parameters describing asymmetry were described. The larger the pain, the lesser the weight on the injured leg, the smaller the reported CoP magnitudes and the larger the perturbation of the shape of the injured CoP trajectory. At this stage, one may emphasise the lack of correlation between the perimalleolus oedema and postural control performance.

Because pain stimulus solicits generally both nociceptive and proprioceptors, which can be both conduced by the anterolateral pathways, it can be hypothesised that pain could modulate the ability to detect and characterise proprioceptive inputs hence explaining the perturbations observed under the injured leg. In parallel, an important emotional component exists in pain detection, rendering conceivable that, after ankle sprain, some strategies can be built in order to limit the nociceptive inputs. In this objective, one possibility offered to the patients could be to limit injured ankle joint constraints by reducing the load applied on this leg or by limiting their joint movements. An ankle stiffening, in order to limit nociceptive inputs, could explain some limited plantar CoP longitudinal excursions under the injured leg.

**Patients with mild and moderate ankle sprain were as much balanced as normals**

Even though some patients suffering from a degree I occurred more than 1 year before, it may at first sight appear as interfering with our conclusions. However, these two patients certify to have plainly recovered from these previous injuries and were thus included in the ordinary course of the protocol. Following ankle sprain, it was clearly shown that the mean CoPRes magnitude and frequency distribution remain unchanged during upright stance maintenance. Rigorously, CoPRes trajectories (or CoP for a simple force platform) do not directly reflect the postural sway, which could be advantageously quantified through the CoG displacements. As demonstrated (Bremiere, 1996), if CoPRes magnitude and frequency bandwidth remain unchanged, the magnitude of CoG displacements remain necessarily constant. Despite important changes observed at a plantar level, ankle sprain patients were as stable as the control group. Considering that the objective of the exercise was to minimise body motions, one can thus say that both sample groups developed a similar postural performance. Interestingly, by an enhanced involvement of their sound leg, ankle sprain patients were able to stabilise their equilibrium as do asymmetric healthy subjects.

**Postural function is largely restored during the first 10 days after the injury**

A critical period for the restoration of postural function following lateral ankle sprain seems to be the first 10 days following the injury (Renstrom & Konradsen, 1997). During this period, (1) weight-bearing asymmetry is largely reduced, (2) asymmetry of magnitude of plantar ground reaction forces variations is totally suppressed and (3) perturbation of the pattern of CoP trajectories under the injured leg ceases and returns to normal behavior. From D10 to D30, only the weight-bearing asymmetry of the ankle sprain patients continues to change and is nonetheless totally suppressed at D30.

It is worth noting that pain is largely reduced over the first 10 days [pain in upright stance: 19.9 (± 19.1) mm at D0 vs 6.4 (± 9.2) mm at D10, \( P < 0.001 \)], whereas there is no statistical difference over the next 20 days [1.9 (± 8.4) mm at D30, \( P > 0.05 \)]. Associated with the reduction of the inflammatory mechanism (Renstrom & Konradsen, 1997), the pain reduction could largely explain the functional postural restoration of ankle sprain patients. Thus, the restoration of the weight-bearing symmetry could certainly be explained by both the reduction of pain and by the reshaping of the ligament collagen occurring from D10 to D30 (Renstrom & Konradsen, 1997).

Interestingly, the data obtained through this study have shown that two-legged protocols are able to differentiate the postural behavior of ankle sprain patients from healthy subjects required to adopt an asymmetrical weightbearing and also to emphasise
the follow-up in this domain. This capacity is worth noting because a large part of these patients do not always get ready to charge their whole body weight on their injured leg.

This study was undertaken in a group of patients involving ankle sprain patients of degrees I and II, according to the grading proposed by Renstrom and Konradsen (1997). Lateral ankle sprain impairs upright stance maintenance early on, directly after the injury. The critical period for the postural restoration seems to be the first 10 days whereas the weight-bearing asymmetry requires a period of 30 days to be suppressed. It is noteworthy that the use of a double force platform is necessary to characterise these postural behaviors.

Perspectives
A future study could be undertaken to investigate whether pain from other causes (blisters, muscle pain, direct trauma, external causes causing discomfort) could bring on similar results and whether these postural improvements are related to more functional tasks. Rigid orthosis is currently worn by ankle sprain patients to concure to the rehabilitation process. One may wonder therefore whether this device could help them to substantially improve their postural control. In addition, how long these devices should be worn from the injury could be assessed by performing successive measures during the rehabilitation. These last points constitute the objectives of the companion study.

Key words: lateral ankle sprain, weight-bearing asymmetry, upright stance, postural control, posturography.

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