Postural studies on whiplash injuries

Pierre-Marie Gagey
Institut de posturologie, Paris, France

The postural study of whiplash victims, seen at the institute of posturology, raises several questions, not always resolved, that merit being discussed.

Why do the great majority of patients present a disharmonious postural syndrome?

What is the significance of a fundamental oscillation of their stabilometric signals at 0.2 Hz?

Is there any particular significance to the asymmetrical electromyographic (EMG) activity of neck muscles in these patients?

What place must be made for the anatomical lesion of the cervical spine among the diagnostic criteria of post-traumatic cervical syndrome?

We will focus our attention on each of these questions, one-by-one.

Disharmonious postural syndrome

The search for an abnormal postural tonic asymmetry forms the basis of the clinical postural examination.

We look for this asymmetry at the level of the axial musculature by means of movements that obey the laws of spinal movement — Lowett's laws (1907), cited and disseminated by Fryette [1] — for example, during the lateral inclination of the spine of the subject standing up. According to Lowett's laws, this movement is accompanied by a contralateral rotation of the lumbar and dorsal vertebrae, easily perceived by gently placing one's hands on the patient's iliac wings and scapulae, while he leans sideward.

We explore distal musculature by means of Fukuda's stepping test [2], with measurement of neck-reflex gains [3].

When the muscle tone is abnormally asymmetrical, we can speak of a «postural syndrome»: it is said to be «harmonious» when the hypertonicity is crossed between the axial and distal musculatures; in the opposite case, the postural syndrome is said to be «disharmonious». Barré's «vertical» provides a visual summary of these postural syndrome analyses (fig. 1).

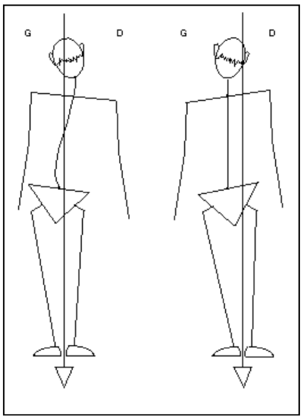

FIG. 1 — Harmonious and disharmonious postural syndromes.
On the left, an harmonious postural syndrome, the hypertonicity of the axial and distal muscles is crossed. On the right, a disharmonious postural syndrome, the hypertonicity of the axial and distal muscles is homolateral. (From Gagey & Weber, Masson, Paris, with permission)

The overwhelming majority of whiplash victims present a disharmonious postural syndrome; they are not the only ones, of course, but this surprisingly high incidence of disharmonious postural syndrome following whiplash is statistically significant.

What does it mean? Uemura and Cohen [4] showed that, by localized destruction of the vestibular nuclei in the monkey, it was possible to induce harmonious or disharmonious postural syndromes depending upon the level of the lesion. However, it is difficult to imagine that whiplash systematically produces a lesion of the vestibular nuclei and even more difficult to think that such a lesion would always occur at the same site. Thus, the meaning of a disharmonious postural syndrome must be sought elsewhere.

A clear-cut asymmetry of the electric activity of the neck muscles almost always exists following whiplash and this does not seem strange when we remember the incidence of cervical articulation lesions caused by this type of trauma. The muscles contract to mitigate the consequences of rupturing ligaments. Could this tonic — organic — asymmetry of the neck muscles be the origin of the disharmonious postural syndrome of whiplash victims? The hypothesis, as yet unproven, is interesting because it emphasizes the postural importance of these muscles, «the veritable braces of the head and neck that act as spatial positioners of the otolithic and visual reference points», according to Boquet's terminology [3].

In addition, the postural importance of these neck muscles is directly demonstrated by stabilometric recordings of these patients: clear-cut, statistically significant asymmetry of the areas of the statokinesigrams appears between the recordings made with the head turned to the right and then to the left (fig. 2).

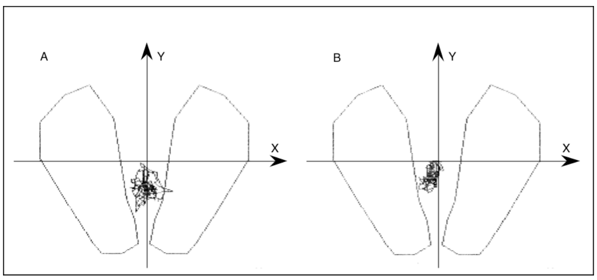

FIG. 2 — Stabilometric recordings with the head turned to the left and to the right.
On the left, the subject's head was turned to the left during the recording session: the area of the statokinesigram is 2 092 mm^2. On the right, the

subject's head was rotated to the right during the recording session; the area of the statokinesigram is 867 mm^2. The ratio of the areas or the cervical quotient is statistically significant: 2.41 ($p < 0.05$).

The fundamental oscillation at 0.2 Hz

Frequency analysis of the stabilometric signals of whiplash victims using the Fourier transform leads very often to the appearance of a fundamental oscillation around 0.2 Hz (fig. 3). This fundamental oscillation at 0.2 Hz appears equally on recordings made with the eyes open or closed.

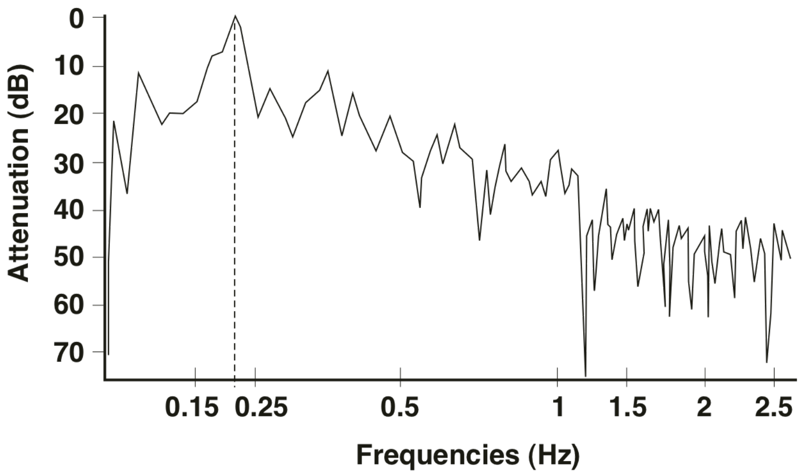

FIG. 3 — Fourier's transform of the stabilometric signals of a whiplash victim.
The fundamental oscillation is evident, clearly separated, at a frequency band of about 0.2 Hz. (From Gagey & Weber, Masson, Paris, with permission)

This 0.2 Hz fundamental oscillation must not be confused with the fundamental oscillation at 0.3 Hz described by Taguchi [5]. The 0.3 Hz frequency corresponds to the resonance frequency of the inverted human pendulum that appears during dysregulations of the fine postural control system of which it is sometimes the only stabilometric witness. This fundamental oscillation simply demonstrates that the postural system is no longer able to damp out this resonance frequency of the human pendulum and lets it pass.

The 0.2 Hz fundamental oscillations have a completely different significance. We showed that a population of patients suffering from rachialgia is characterized by a peak at the frequency of 0.2 Hz, when its mean power spectrum is compared to that of a population of normal subjects [6]. However, this fundamental oscillation is not pathognomonic of a rachidian disorder; it has another origin.

The respiration rhythm is situated in this frequency band of 0.2 Hz; it does not appear [7] or only slightly [8] on the stabilograms of normal standing subjects. Gurfinkel and Elner suggest the possibility of a postural adjustment in preparation of the act of breathing that corrects in advance the postural perturbations resulting from movements of the thoracic cage.

It seems important to emphasize the incidence of the appearance of this respiratory rhythm on the stabilograms of subjects with a rachidian dysfunction because Tardy [9] showed very close relationships between the static spinal musculature and the muscles involved in respiration.

Asymmetry of the EMG activity of the neck muscles

For many years, Boquet [10] has studied comparatively the EMG of the superior heads of the trapezius muscles, left and right, and in whiplash victims he almost always found marked asymmetry of these EMG, with the patient's head in either the normal position (fig. 4) or between positions with the head turned to the left and to the right (fig. 5).

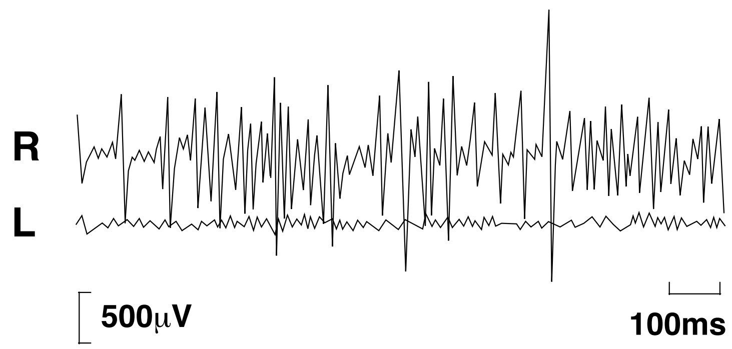

FIG. 4 — EMG of neck muscles

EMG of the superior heads of the right and left trapezius muscles of a whiplash victim with his head in the normal position. The asymmetry of the tracings is obvious. (From Gagey & Weber, Masson, Paris, with permission)

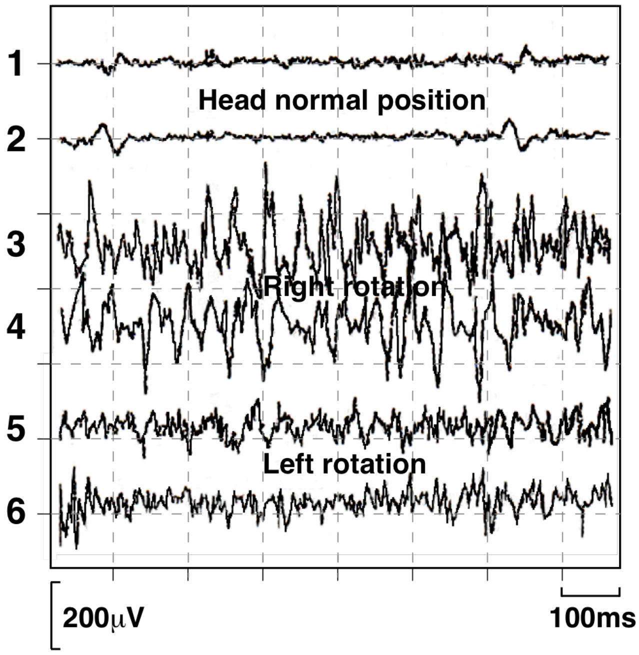

Fig. 5 — EMG of neck muscles
EMG of the superior heads of the right (uneven numbers) and left (even numbers) trapezius muscles. 1 & 2: head in the normal position: 3 & 4: head turned to the right; 5 & 6: head turned to the left. The asymmetry appears when the head is rotated towards the right. (From Gagey & Weber, Masson, Paris, with permission)

What is most remarkable on the EMG tracings of these patients is not only the asymmetry but also the amplitude of electrical activity. Boquet sees in them signs of increased levels of vigilance in these patients, of their emotionality and their basic anxiety. All whiplash victims do not necessarily have postural disorders. A supplementary factor is required that Boquet links to this hypervigilance. According to Boquet, anxious individuals very often have neck pains and they blame it on early arthritis, but wrongly so, because one sees people with arthritis sufficiently severe to generate cracking sounds who do not suffer and do not have contractures, but they are calm individuals. This clinical contrast underlines the increased reactivity of neck neuromuscular spindles when the vigilance level is heightened [10]. This context brings to mind the fundamental studies that demonstrated the noradrenergic innervation of the neuromuscular spindles [11, 12] and, more generally, the influence of the autonomous nervous system on the postural system [13].

Lesions of the cervical spine

Treatment of post-traumatic cervical syndrome by strictly postural techniques (optical prisms, stimulation soles) has been a failure. But clinical posturology has taught us that, behind every failure of postural treatments, a poorly known lesion must be sought. This is indeed the case, well-established today, of mandibular lesions responsible for craniomandibular dysfunctions; we now know that the latter must be treated prior to initiating any postural therapy. This is also true for irritative lesions of plantar pressure points that are able to generate distant postural dysfunction; these lesions must be dealt with first. This hierarchy of treatments is easily explained: prisms and stimulation soles can only modify sensory integration. Addressing the lesion takes precedence over the subtleties of improving sensory integration.

Nowadays, lesions of the cervical spine after whiplash are far from always being poorly known; medical imaging techniques have made enormous progress. Even before the era of computed tomography scanners and magnetic resonance imaging, Gentaz et al. [14]. by multiplying the dynamic incidences for radiography of the cervical spine, had detected obvious signs of cervical sprain: e.g., rupture of the continuity of the posterior wall of the vertebral bodies (fig. 6) or overlapping of posterior articulations.

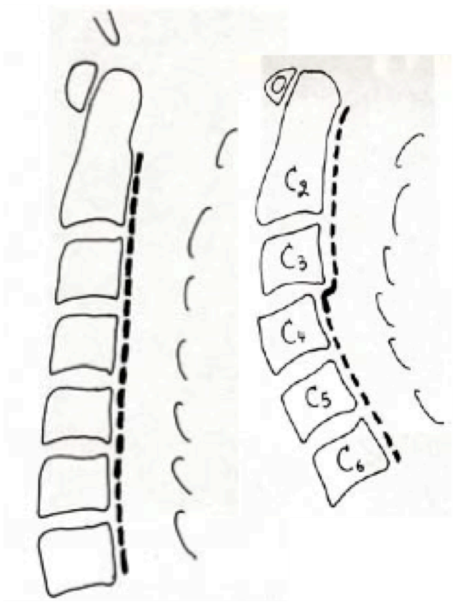

FIG. 6 — Posterior walls, normal and after cervical sprain.

Normally, the posterior faces of the vertebral bodies remain perfectly aligned, even during hyperflexion and hyperextension of the neck. When a step-like shift appears in this posterior wall (between C3 and C4 in the drawing on the right of fig. 6), a ligament has been torn, the neck sprained. These shifts only appear frequently in dynamic positions, in this case, hyperextension.

Discovery of a cervical lesion subsequent to whiplash seems so important that we are tempted to say that no diagnosis of posttraumatic cervical syndrome can be made in its absence, especially when the whiplash is not recent. As long as the lesion is not found, it must be sought with perseverance. If, despite the multiplication of tests, the lesion is not seen, the diagnosis should remain highly suspect. The neck is the privileged site of expression of all sorts of «distant» pathologies: oculomotor — for example strabismal torticollis —, occlusive, spinal and even plantar, that have nothing to do with whiplash. The cervical spine is a trap for the clinician.

Treatment

It is useless to apply postural techniques to treat a whiplash victim with a cervical sprain. Therapy of the lesion takes precedence over attempts to manipulate sensory integration.

In contrast, Boquet insists upon the necessity to treat from the start the excessive anxiety, translated as permanent neurectasia, of these patients. The therapeutic strategy that he recommends is myoresolutive and sedative. The treatment starts with a diazepam (20 mg.l^{-1}) drip, in combination with alpha- and betablockers that reduce the activity of the autonomous nervous system, and the dosages are adjusted until the desired levels of vigilance and muscular tonus are obtained for each subject. Once the patient is «relaxed», work can begin on the neck.

Conclusion

For more that one hundred years, since the studies by Longet, we have known that the neck muscles are involved in postural control and we confirm this knowledge every day in whiplash victims.

But, over merely the past few years, our attention has been drawn towards the overall level of vigilance of these patients that must be taken into account before starting therapy.

We are also better able to explore the traps posed by the cervical spine, where numerous postural tonic pathologies can express themselves without any local lesion. These observations lead us to insist upon the search for signs of cervical sprain using all available means of medical imaging before settling on a diagnosis of whiplash.

The discovery of a cervical lesion is extremely important for determining the therapeutic strategy — it formally counter indicates the use of any postural techniques.

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(Oral presentation during the Milan Congress (December 1995) on the whiplash injuries, organized by Pr. A. Cesarani and Dr. D. Alpini.)