

272 We also looked for various sub-types, primarily
273 vestibular versus non-vestibular patterns, using criteria
274 2, 4 and 5 of Mallinson and Longridge. Some
275 of the patients distinctly showed either a vestibular
276 (where C5 and C6 are primarily affected) or a
277 non vestibular pattern (C1 and C2 markedly lower
278 than normal or C5 and C6 relatively better than C1
279 and C2), but that was not linked in a significant
280 matter to any of the clinical or instrumental assessments,
281 notably to vestibular deficits. We found a few
282 patients with a positive $n^{\circ}5$ criteria of Mallinson and
283 Longridge, but none of these subtypes where in sufficient
284 number to conclude that they are indicative
285 of CSD.

286 80% of our patients showed a shrinkage and/or a
287 displacement of their centre of gravit, numbers that
288 are similar to previous published data [18]. Together
289 with the high amount of abnormal LOS we found,
290 it suggests a sensory disorganization of the balance
291 system with inappropriate responses in postural control.
292 Another hypothesis could be a fear to fall during
293 the testing. Indeed our patient sample has a high
294 rate of concomitant anxiety disorders. A correlation
295 between anxiety disorders and abnormal posturographic
296 findings, mostly enhanced antero-posterior sway,
297 has already been reported [10]. Redfern et al.
298 [19] found a greater sway in response to moving
299 visual environment in anxious patients with space
300 and motion disorder (SMD) in comparison to healthy
301 subjects, but also in comparison to anxious patients
302 without SMD. They conclude that patients with anxiety
303 disorders are more visually dependent for balance.
304 In our study, patients with known or treated anxiety
305 disorders didn't performed worse than non anxious
306 patients.

307 A recent study compared SOT scores of patients
308 with persistent postural-perceptual dizziness (PPPD)
309 with normal control subjects and recovered vestibular
310 patients [21]. PPPD was recently described by the
311 Barany Society and its diagnostic criteria are derived
312 from phobic postural vertigo and CSD [23]. Our data
313 was recorded before this entity was described, but
314 PPPD should be used as the generic term in future
315 publications. This study showed that patients with
316 PPPD perform poorer than subjects in the recovered
317 group and control group, with greater deficits
318 in mean scores across all SOT conditions except C1.
319 They also came to the conclusion that poorer performances
320 on SOT in these patients are probably caused
321 by the confluence of three factors: excessive visual
322 or somatosensory dependence, anxiety and use of
323 high-risk postural strategies when not needed.

324 Our study is in line with these results; the high rate
325 of abnormal posturographies and variability of results
326 with many different subtypes among patients with
327 CSD suggest a sensory disorganization of their balance
328 system that finally leads to various responses in
329 term of postural control. We think that all the parameters
330 that could influence the posturographic results
331 (prior vestibular disorder, visual or somatosensory
332 dependence, anxiety, use of high-risk postural strategies
333 when they are not needed, . . .) can lead to various
334 posturographic patterns, thus failing to identify a specific
335 pattern for this condition.

336 Vestibular therapy has already shown its value
337 in the treatment of vestibular disorders [4, 5]. In
338 our study, the post VR CDP's showed a significant
339 improvement compared to the assessment ones (79%
340 abnormal initially vs 33% post rehabilitation, Fig. 2).
341 It confirms the value of this type of treatment for
342 CSD. Patients with head concussion syndrome seem
343 to benefit the most. In a randomized control trial,
344 Andersson et al. [1] found a significant improvement
345 in the self-reported dizziness handicap inventory and
346 the vertigo symptom scale in patients that had VR
347 plus cognitive-behavior therapy compared to controls,
348 which showed no improvement at all. Due to its
349 retrospective design, our study lacks a control
350 group, so the improvement rate is to take with caution.
351 Nevertheless, 57% of the patients that had a VR
352 demonstrated an improvement on the CDP, a response
353 rate that is comparable to sertraline treatment in
354 another study [27]. Most importantly, 79% of the
355 patients reported a subjective improvement when this
356 parameter has been assessed (Fig. 2). The post-VR
357 posturography also allows the physical therapist and
358 the patient to objective and validate the progresses,
359 or to accept failure of the treatment and the need
360 for a complementary approach. Thus we recommend
361 VR as the first line treatment for CSD, considering
362 its reasonable efficacy without potential secondary
363 effects as compared to pharmacological treatment.
364 Moreover, it can include do-it-at-home, in-situation
365 and cognitive-behavioral exercises, offering a wide
366 room for individualization of the treatment. Nevertheless,
367 a psychiatric evaluation in addition to vestibular
368 testing is advocated in cases of major psychiatric
369 disorders and phobia, where combined treatments and
370 multidisciplinary approach is mandatory.

371 5. Conclusion

372 Patients with chronic subjective dizziness have a
373 high rate of abnormal balance test, without a specific

pattern on the computerized dynamic posturography. Vestibular rehabilitation is an effective tool in the therapeutic armamentarium.

Conflicts of interest

The authors declare that there are no conflicts of interest.

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