

Comparison of Short and Long Clinical Perceptive Maddox Assessments for the Evaluation of the Contribution of the Podal Modality in Sensory Integration Disorders and Dys Proprioception Syndrome. What are the Differences? What is the use in Current Practice?

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Abstract

Resum: The participation of the podal system in different pathologies can be assessed by numerous clinical tests. In the specific context of Dys Proprioception Syndrome (DPS), but not exhaustive due to the overlap with Sensori Porcessing Disorder (SPD), Quercia, *et al.* assess its participation by 4 items (short form, SF). In 2018, Janin suggests to complete this assessment by adding 7 more items, i.e. 11 items (long form, LF). This latter proposal presents 4 items that are commonly used in podiatry, 1 of which assesses foot insoles. However, these items would not appear to be useful for other health professionals. Only between the SF and LF versions, even if 4 items are removed, there remains a differential that can constitute the median form (MF). The objective of our work was to evaluate the clinical relevance of these 3 forms: SF, MF, LF in determining the participation of the podal system in regulating, disturbing and indifferent in clinical practice. The evaluation was conducted in two parts: 1) on 104 subjects: SDP, DPS and normal (control, C); 2) on subjects with plantar afference inefficiency. Their scores on the 3 forms SF, MF, LF were compared (inter and intra group). Regardless of the form, the C subjects differed from all other subjects. Overall, the LF and FM scores are not different from each other but they are different from the LF scores. Mainly with regard to the involvement of the podal system and its determination as a disruptor and regulator. In practice, management and therapeutic orientation, as the LF and FM scores are identical, the FM is sufficient as it is largely complementary to the SF. The LF remains essential for the podiatrist, mainly in the evaluation of foot orthosis treatment. All 3 forms can be used for multidisciplinary treatment assessment and follow-up.

Context: Whatever the medical specialty, clinical evaluation makes it possible to establish a diagnosis and set up a therapeutic proposal. Many reviews are available and come in short or long form. The selection of these different forms is dependent or determined by the professional objective. The objective of this study was twofold: firstly, to compare the results of the different forms of evaluation (short or long) then to check their concordances and secondly, to evaluate the contribution of the podal modality by them.

Keywords: *Multidisciplinary Evaluation; Therapeutic Evaluations; Podiatry; Perceptive Maddox; Efficiency of Plantar Afferences; Inefficiency of Plantar Afferences*

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Introduction

In daily life, the multisensory integration of modalities: visual, auditory, proprioceptive and tactile allows the subject's interaction with / in his environment [1-3]. The alteration of this multisensory integration is reported in several pathologies and / or syndromes (syndrome: set of clinical signs and symptoms that a patient is likely to present during certain diseases or in clinical circumstances of deviation from the standard, not necessarily pathological) such as for example Sensory Integration Syndromes included in DSM-5 (Sensory Processing Disorder or Sensory Integration Dysfunction, SPD or SID, 4 - 8) or Dys Proprioception Syndrome (DPS, 9).

In the specific context of neurodevelopmental syndrome and due to the overlap between the DPS, the SPDs and the SIDs, Quercia and its collaborators evaluate the participation of the podal modality by the Perceptive Maddox (PM, 10, 11). The Maddox rod test commonly used in ophthalmology has also evolved due to the fact that scientific and clinical data have specified "how" to assess the slightest heterophorias. Going from a simple "Maddox rod test", it becomes "Postural Maddox" to evolve into "Perceptive Maddox" (PM) by localizing the vertical heterophoria (VH) allowing a complementary and more precise analysis and sensory evaluation than previous tests. The starting tool does not change and remains the "Maddox". It is the analysis that we make of the outcome that changes and evolves. PM thus alters the fusion of both retinal images in the vertical plan. It is very important to mention that PM targeted vertical heterophoria rather than horizontal heterophoria, because the possibility of natural compensation is weak. During the PM, a VH latent angular deviation may occur in the vertical plan. The exact orientation of both eyes on the light can become less stable, because it is controlled only by ocular proprioception and corollary discharge [9,13]. Therefore PM, manipulation of visual perception while enhancing the roles of ocular proprioception and corollary discharge, assesses the participation, interactions and reciprocal influences of different sensory modalities (i.e. visual, auditory, stomatognathic, proprioceptive and tactile, 11-14). It targets the performance and the stability of this useful and necessary information for sensory and motor binocular fusion. PM is a clinical test that is reproducible between and intra practitioner [15] as well as between and within clinical evaluation conditions [16]. It therefore complies with the guidelines for clinical evaluations recommended in podiatry [17] and can be used by all healthcare professionals [18].

In the management of DPS, Quercia and its collaborators propose an evaluation protocol with the PM comprising 7 items [9-11]. In this procedure, the foot modality is determined by comparing the results obtained through 4 items: the variation between sitting with contact, sitting without contact, standing on hard ground and standing on fine foam (short form, SF; 9, 10, 11). They are created to modify the perception of the afferent foot cues and then objective their influences on the PM (ocular proprioception and corollary discharge). Depending on the results, the podal modality can be disruptive, indifferent or regulatory. In 2018, Janin proposed to complete this evaluation by adding 7 other items: sitting with contact on thin foam (1 item), sitting with contact and standing on thick foam (2 items), sitting with contact and standing on Black Pyramid® (2 items), standing with shoes (1 item) and standing with plantar orthotics (1 item). These 11 items constitute the long form (LF, 19). It recommends keeping the original classification of the participation of the podal modality proposed by Quercia and its collaborators: disruptive, indifferent or regulating. However, in the additional items offered by Janin in the long LF form, the 6 items: sitting with contact on thick foam, standing on thick foam, sitting with contact on Black Pyramid® (Crispin Medical France), standing on Black Pyramid®, standing with foot orthoses, and standing with shoes can make the assessment time-consuming. It offers a median form (MF), comprising 5 items: the 4 items of Quercia and collaborators (SF) and to complete it with an item: sitting with contact on fine foam (these 4 situations are common with LF).

The three forms, SF, MF, LF of podal modality assessment are derived from the original clinical assessment used in the assessment of DPS subjects [9-11]. The inter and intra practitioner reproducibility of PM has been established in populations of healthy subjects [16] and in dyslexic subjects (subjects with difficulty in learning to spell and read, 15). Due to the robustness of the test, we wanted to assess their ability to objectify the foot modality in subjects with Plantar Afference Inefficiency (PAI, 20), characterized by Foisy and Kapoula [20]

by a Plantar Quotient lower than 100 (PQ). The PQ is defined by the ratio between the surface of the oscillations of the subject covered on Depron® 6mm and that covered on hard ground multiplied by 100 [21]. The subject who exhibits a PQ < 100 is surprisingly more stable on Depron® 6mm than on hard ground [20,21]. According to Foisy and Kapoula, PAI subjects would not be able to perceive and take into account the sensory variations of the plantar sole useful and necessary for postural control. Therefore, as their podal modality is not sensitive to sensory variations, it is very likely that PAI subjects the podal modality would not induce any variations in proprioception and the distribution of ocular muscle tone. It should be classified as indifferent by the 3 forms. In this case we could propose the selective use of one form over the other according to the clinical objectives and the professions

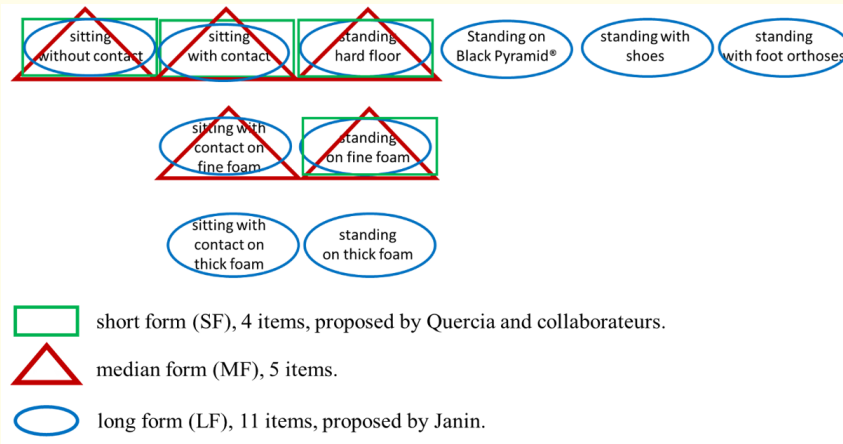


Figure 1

Aims

To respond to clinical practice, the objective of our study was to compare the three forms of clinical evaluation in different populations. This study was conducted in two steps.

The first step was to compare the results of the 3 different forms of PM in a sensory deficient population DPS, SPDs and SIDs to assess the clinical relevance of these 3 forms: SF, MF, LF to objectify the participation of the podal system: regulator, disruptor or indifferent to PM. The second step was to compare the three forms of clinical evaluation to test the robustness of the results in an PAI population to allow to propose the preferential use of one of the forms compared to the others.

The first step compare the results of the 3 different forms of PM in a sensory deficient population DPS, SPDs and SIDs.

Material and Method

104 subjects were included in 4 groups: 26 normal readers (C control subjects); 26 DPS and dyslexic subjects (SDPdys); 26 SDP subjects and 26 DPS subjects. Each subject was evaluated according to the 3 forms (SF, MF, LF) after drawing lots. The participation of the podal modality was evaluated in the MP according to the procedure of Quercia and his collaborators [9,10,13,14] by localizing the

vertical phoria in each successive sensory condition then making it possible to determine its participation in: - regulatory: condition sensory which allows a return to physiology orthophoria; - disruptive: sensory condition that causes a pathological response modification of the phoria (i.e orthophoria to VH or the variation of the position of the HV on one eye) and - indifferent: sensory condition causing no change (VH to VH without changes of positions on both eyes). The scores of the three forms (SF, MF, LF) were compared (between groups and within groups). The study was registered under number RCB Medical Devices 2016-A01062-49 / MJ2018 and corresponds to the recommendations of the Declaration of Helsinki.

Results

Regardless of the form, C subjects differ from all other subjects. Overall, LF and MF scores are almost similar but different from SF scores, mainly with regard to determining the foot modality as disruptive and regulatory.

C				DPSDys			
en %	Disruptive	Regulatory	Indifferent	en %	Disruptive	Regulatory	Indifferent
FC	6	14	80	FC	28	34	38
FM	9	20	71	FM	30	46	24
FL	18	30	52	FL	39	54	7

DPS				SPD ou SID			
en %	Disruptive	Regulatory	Indifferent	en %	Disruptive	Regulatory	Indifferent
FC	26	38	36	FC	20	27	53
FM	27	43	30	FM	28	43	29
FL	38	52	10	FL	40	50	10

Table 1

Legend

Participation of the podal modality according to the populations in%. C: subject control; DPSDys: subject Dys Proprioception Syndrome and Dyslexic; DPS: subject Dys Proprioception Syndrome; SPD or SID: subject Sensori Porcessing Disorder or Sensory Integration Dysfunction; SF: Short form of the rating scale (4 items); MF: Average form of the rating scale (5 items); LF: Long form the rating scale (11 items).

The second step was to compare the three forms of clinical evaluation to test the robustness of the results in a PAI population to allow to propose the preferential use of one of the forms compared to the others.

Hypotheses

Therefore, since SF, MF and LF, vary plantar sensory information, the scores for these three forms should be the same and show no variation.

Material and Method

40 subjects, without evoked foot pain, without trauma to the lower limbs, without neurological disorder and without particular pain were selected by their PQ < 100 on the Fusyo® platform (Medicapture France, 30s, 40Hz, target at 5 meters at eye level, hard ground and Depron® conditions randomized). Each subject was evaluated according to the 3 forms (SF, MF, LF) after drawing lots. The study was registered under number RCB Medical Devices 2016-A01062-49 / MJ2020 and corresponds to the recommendations of the Declaration of Helsinki.

Results

Whatever the form of assessment (SF, MF, LF), the classification of the foot modality is different between the items. In each of them we find the three types of participation of the foot modality: regulatory, disruptive and indifferent. Similar to the first study presented above the LF and MF scores are almost identical. The SF, the shortest form, despite its 4 items shows variations in participation.

Inefficiency des Afférences Plantaires			
en %	Disruptive	Regulatory	Indifferent
FC	17	24	59
FM	20	33	47
FL	33	42	25

Table 2

Legend

Participation of the foot modality in subjects with Plantar Afférence Inefficiency in%; SF: Short form of the rating scale (4 items); MF: Average form of the rating scale (5 items); LF: Long form the rating scale (11 items).

Discussion

The objective of our study was to assess the clinical relevance of these 3 forms: SF, MF, LF to objectify the participation of the podal system: regulator, disruptor or indifferent for clinical evaluations in different populations in two steps: 1) compare the results of the 3 different forms of MP in a sensory deficient population DPS, SPDs and SIDs to PM and 2) compare the robustness of the results of the 3 forms in Sensory Integration Syndromes SPD or SID; Dys Proprioception Syndrome (DPS, 9) and PAI population to allow to propose the preferential use of one of the forms compared to the others.

1 SF, MF, LF to objectify the participation of the podal system: regulator, disruptor or indifferent

The 3 forms make it possible to classify the participation of the podal modality, regardless of the number of items they contain. Therefore, the observations of Quercia and his collaborators al. remain valid and Janin's proposal to develop this procedure is relevant. In regard f the results expose in table n°1, the LF and MF scores are almost identical, whatever the population, MF is sufficient in management and therapeutic orientation because it is largely complementary to SF. The SF groups together that the items related to the participation of the podal modality appear insufficient in the evaluation procedure proposed by Quercia and his collaborators [10,11]. LF remains more specific in podiatry, for the evaluation of treatment and the design of plantar orthotics [19] because it is more discriminative, thus allowing a better evaluation of the effects of the materials. All three forms of assessment can be used for monitoring multidisciplinary treatment in the management of neurodevelopmental disorders and PDS. Depending on the profession practiced, the assessment procedures should not be restrictive and rigid, but may change depending on individual clinical objectives and future research. The procedure proposed today remains the simplest for better communication and multidisciplinary care.

2 Comparison of the results robustness of the 3 forms in a PAI population

Foisy and Kapoula characterized subjects PAI [20] by a Plantar Quotient lower than 100 and they would not be able to perceive and take into account the sensory variations of the plantar sole useful and necessary for postural control. The sensory variations of the plantar sole was induced by Depron® procedure that would be equivalent for them to the interposition of a foam. Then subjects with PAI should be classified as indifferent by the 3 forms. Furthermore the three forms SF, MF and LF induce sensory variations in very simplistic ways such as placing the foot in contact with the ground or sitting with contact and standing upright, more specifically by reducing or increasing plantar afference respectively by interposing foam or Black Pyramid® and selectively by foot orthoses or standing with shoes. Our results are opposed to our hypothesis: the three forms of assessment exhibit different participations of the foot modality while the PAI subjects who normally for Foisy and Kapoula do not take into account these variations in postural control. We can offer several explanations. First, SF, MF and LF evaluations are performed with foams that do not match Depron® 6mm. However, these foams (3 and 5 mm) proposed in the 3 forms are in agreement with the work of Cohen and Sangi-Haghpeykar [22] and that of Vieira and his collaborators [23]. They are able to induce sensory variations allowing the differentiation between healthy subjects and pathological subjects. Second, PAI subjects do not take their foot modality into account to their control of posture [20, 21]. Posture control is only one of the three columns of PDS that the PM assesses: altered muscle tone distribution, disturbance of spatial localisation and transient perceptual disturbance of multi-sensory integration [9,24]. In other words, the PM mainly assesses the involvement of the foot modality in the three sectors of the SDP, of which posture control is a part but not only. Therefore, SF, MF and LF would evaluate the participation of the foot modality much more finely compared to the PQ. Finally, the selected subjects presented with PAI, but we did not assess whether or not they presented with DPS [9] or SPD [5-8]. It was also our objective to assess the robustness of the different forms of assessment that we offer. It is likely that these results are obtained because PD accounts for multisensory integration that is different from postural control [1-3,22-24].

3 What uses of perceptive maddox in current practice?

The SF is made up of 4 items concerning the podal modality of the original form proposed by Quercia and his collaborators [9,10,24]. The latter obviously remains the originator. At the podiatric level, and for medical specialties which are interested in the participation of the foot pod modality in different pathologies or syndromes, FM provides additional clues. It then makes it possible to better orient the therapeutic proposal. LF remains recommended for first-line podiatrists because it specifies the participation of this modality in relation to the podological assessment and diagnosis for the realization of plantar orthotics. However, there is a difference between research and clinical practice. In research, the protocol cannot be changed, while in clinical practice with the patient remaining at the heart of the treatment, the evaluation may take different directions. Clinical practices, even among podiatrists, are very different depending on the sensitivity of the practitioner. Adherence to the forms of assessment is recommended, but the proposal to use LF for chiropodists should not prevent clinicians from tailoring the PM test to their clinical goals. For example, Laborie and Janin use the PM to define the participation of the quadrants of the plantar sole and to specify the location of the stimuli and their effects [25]. Likewise, Loureau and colleagues demonstrate the differentiated effect of Airgom® and Crispondiabet® foams (Crispin Médical France, 26) while their mechanical characteristics are similar. Finally, Biteau and colleagues, show that a high lability of the PM influences the walking rate of the subjects [27]. These procedures complement, if necessary, the clinical examination either as a first-line or as a follow-up consultation. The proposals made here may be subject to change depending on scientific and clinical data.

Conclusion

The results of the two studies confirm that the three forms SF, MF, LF, are, on the one hand, complementary during clinical evaluations in current practice and on the other hand, they allow in a differentiated way to evaluate the participation of the modality. podale both

in subjects with PAI [20] and in the management of Neuro-Developmental Disorders [1-3,5-15]. Their results, in addition to clinical evaluations (questionnaires, tests, etc.), make it possible to establish appropriate and consensual therapeutic management.

Summary

SF is useful for screening, usable by all therapists (doctor, orthoptist, physiotherapist and others...), MF allows clarification on the participation of the podal system useful in evaluation and monitoring of treatment. It may be of secondary use in cases of differential diagnosis or delayed progress in treatment. LF is recommended for podiatrists. "It is essential to realize that the response of Binocular Fusion during sensory variations of the podal modality evaluated by the Perceptive Maddox exposes the fact that we observe the response of this modality in multisensory integration. Thus the classification of a sensor as a "disruptor" is not pathological in itself, it only induces an imbalance of the system at the precise moment of the examination and in the present state of the system" Dr Floesser-Codello Régine [28].

Authors Contribution

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