Consideration of PICA Subtest Variability in Cases of Aphasia Secondary to Blunt Head Trauma

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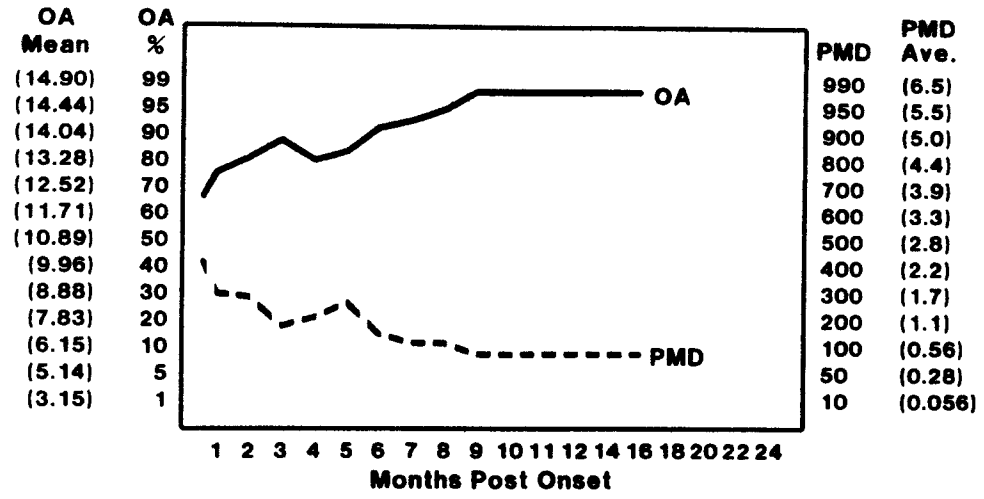
INTRODUCTION

Cases of aphasia caused by blunt head injury frequently present difficulties in prognosis and treatment for the speech pathologist. Heilman et al. (1971) determined that language recovery from closed head injury varies greatly, without constant relationships to aid the clinician in predicting prognosis. Patients vary in type of aphasia and in the presence and severity of concomitant disorders affecting communication. Higher level disturbances frequently accompany aphasia resulting from closed head injury (Levin et al., 1976). Groher (1977) found that closed head trauma patients initially manifest both aphasic and confused language skills--including "faulty short term memory, mistaken reasoning, inappropriate behavior, poor understanding of the environment, and disorientation."

In an attempt to provide a method for determining prognosis for recovery from aphasia, Porch (1978) examined the variability patients exhibit in responding to the ten items within each of the 18 subtests on the PICA (Porch Index of Communicative Ability). He developed the Peak Mean Difference (PMD) as a measure of this intrasubtest variability, and attempted to relate variability to prognosis. Calculation of the PMD involves subtracting the mean score of each subtest from the peak score of that subtest, and summing these values for each of the 18 subtests. That value is then multiplied by ten to obtain the PMD. Porch theorized that a high variability (reflected in a large PMD) identified potential for improvement, because patients should be able to achieve homogeneity of scores within a subtest. That is, they should be able to bring all scores up to the peak score on a given task.

Aten and Lyon (1978) examined the effectiveness of the PMD in predicting recovery for a group of aphasic subjects and found only "minimal relatedness" between PMD's and change in Overall PICA scores over time. Porch and Callaghan (1981) reexamined the PMD and found that PMD's tend to follow three patterns in stroke patients as PICA Overall scores increase; the C, F, and Line pattern (Figure 1).

The "C" pattern was reported to be related to lesions in the posterior area of the brain and the "F" pattern to lesions in the middle cerebral artery area of the brain. The line pattern was an enigma. Several correlations between PMD's and recovery in patients with aphasia for each of the recovery patterns were identified. However, a number of questions remain unanswered. Do the localizations of brain damage in "C" and "F" patterns found in aphasia secondary to stroke apply to aphasia secondary to diffuse brain damage? If not, do patients with diffuse brain damage show a characteristic pattern of their own? Is the PMD useful as a predictor of recovery in treatment to the clinician? This paper examines such questions through an examination of PICA recovery patterns of blunt head trauma patients.



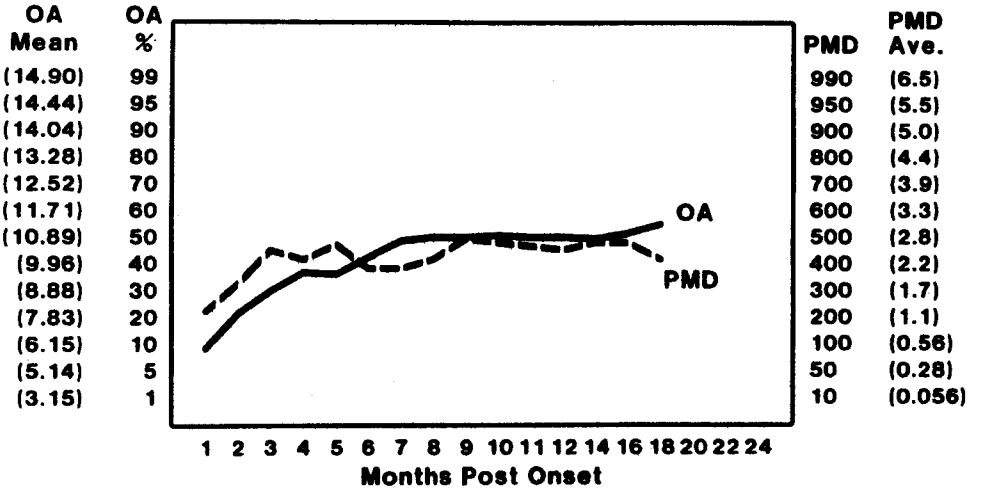


Figure 1. Falling Peak Mean Difference producing "C" (upper) and "F" (lower) shaped patterns. (Porch and Callaghan, 1981)

SUBJECTS

A retrospective study was performed on cases of aphasia caused by blunt head trauma treated at the Jefferson Barracks Veterans Administration Medical Center, St. Louis, Missouri. All patients had been referred to and treated by the Audiology and Speech Pathology Service. The Speech Pathology Clinic files for the past ten years were reviewed and all patients with a medical diagnosis of blunt head trauma who had received at least two PICA tests (Porch, 1967) were considered as subjects for this study. Of the 16 cases of blunt head trauma found, three who did not show improvement (as measured by the PICA) were eliminated from the study. The remaining 13 showed some degree of recovery. Twelve incurred closed head injury; one incurred open, though blunt, diffuse head injury. The interval between date of injury and first PICA Test, the intervals of time between PICA

testings, the amount of treatment given, and the number of treatment sessions between testings were not controlled.

PROCEDURE

PMD's were calculated for each PICA test and were graphed against Overall PICA scores. These plots were examined for relationships between change in Overall PICA scores and change in PMD's.

RESULTS

Of the 13 patients, seven exhibited Porch's "C" pattern--PMD's fall as Overall PICA scores rise (Figure 2). Their patterns look similar to the one presented in Figure 1. The data were graphed in terms of PMD's vs. Overall scores.

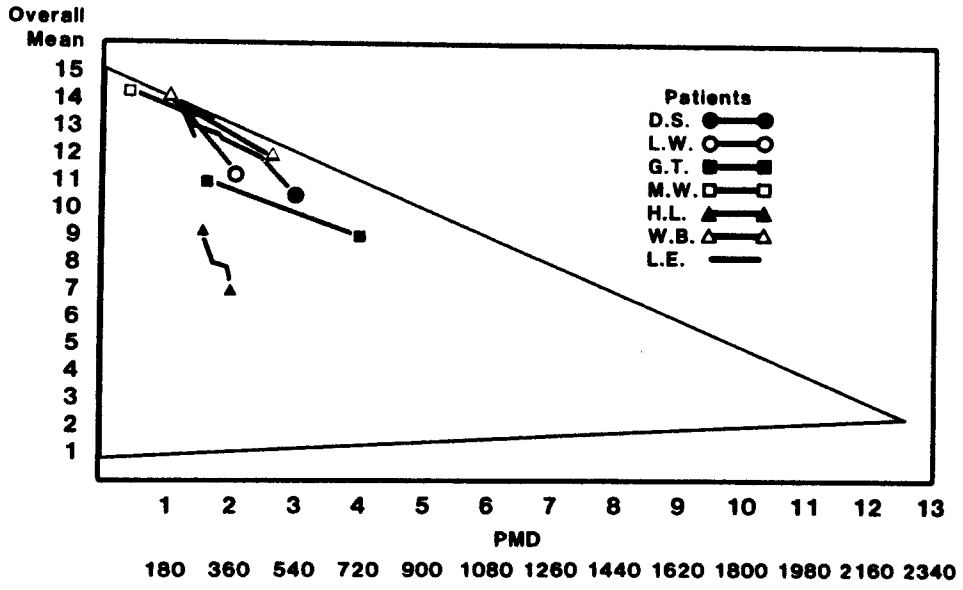


Figure 2. Overall PICA means vs. PMD's for seven blunt head trauma patients showing "C" pattern.

The remaining six patients showed no consistent relationship between change in Overall scores and change in PMD's over time. One showed an "F" pattern, while others showed "F" patterns (rising PMD's) followed by "C" patterns (falling PMD's) as Overall scores rose. The data for these six patients were also graphed in terms of PMD's vs. Overall PICA scores (Figure 3).

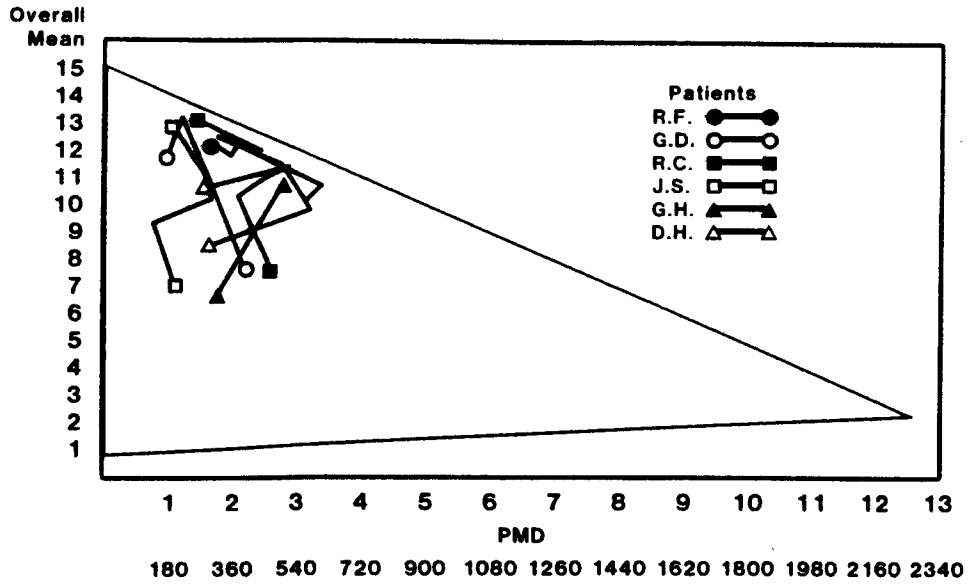


Figure 3. Overall PICA means vs. PMD's for six blunt head trauma patients who show no definitive pattern.

DISCUSSION

Initially we were tempted to conclude that the lack of a consistent PMD pattern in patients with aphasia caused by blunt head injury reflects diffuse brain damage rather than the localized injury reported by Porch for his "C" and "F" patterns. However, inspection of the initial Overall PICA scores of our seven patients exhibiting the "C" pattern reveals that their Overall PICA scores tended to be higher (mean OA = 11.3) than the initial Overall PICA scores for the remaining six patients (mean OA = 8.2). Looking at Porch and Callaghan's (1981) data revealed that their patients exhibiting a "C" pattern also tended to have higher initial Overall PICA scores (mean = 10.8) than those showing an "F" pattern (mean = 7.8) (Figure 4). These findings raised the question as to whether PMD "C" and "F" patterns are related to the level of the initial PICA Overall score.

An important concept in considering any data involving the PMD is the following. For every Overall PICA score there exists a maximum PMD that the score is capable of manifesting. Purely mathematical constraints prevent a higher PMD for that particular Overall score. The maximum possible PMD values for each Overall score were determined for the PICA scale ranging from 1 to 15. They are presented in Figure 5. For example, a patient whose Overall PICA score is 13 can manifest a PMD no greater than 360. On the other hand, a patient whose Overall PICA score is 6 could hypothetically have a PMD as large as 1620.

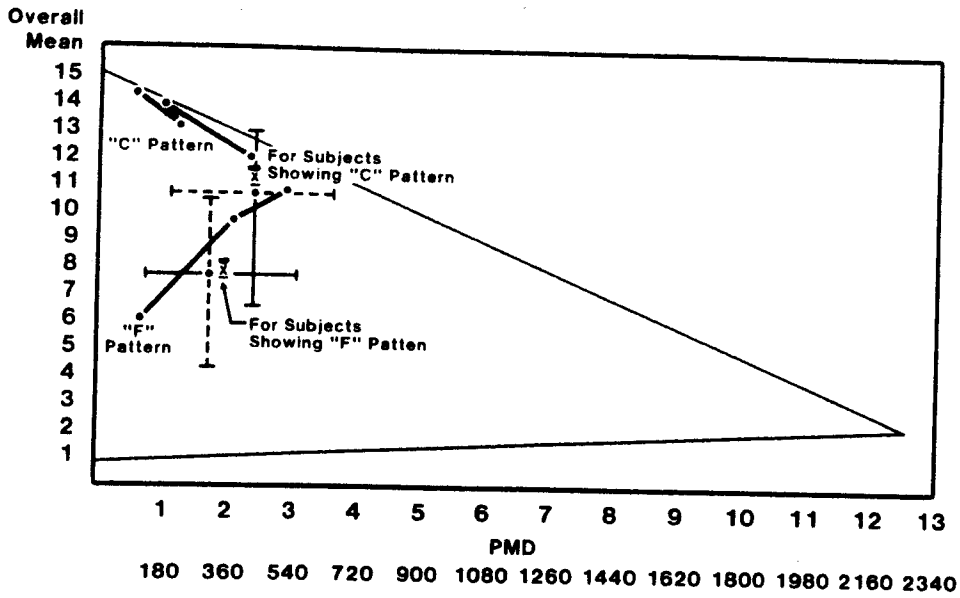


Figure 4. Mean and range of initial PMD and Overall PICA scores for Porch and Callaghan"s (1981) "F" and "C" pattern patients. Also shown is a typical "C" pattern patient and a typical "F" pattern patient.

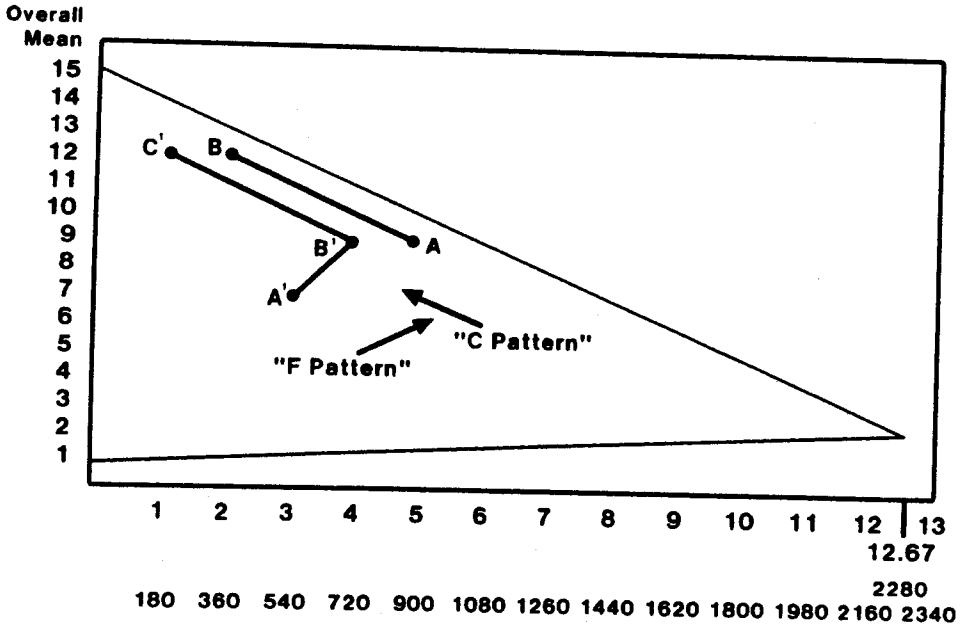


Figure 5. Overall PICA means vs. PMD's showing maximum PMD values (on a scale from 1 to 15).

It becomes apparent that for certain PMD Overall score combinations, a rise in the mean must be accompanied by a fall in the PMD. For example, if a patient with an initial score of 9.0 and a PMD of 720 (point A in Figure 5) brings his or her score up to 12.0, the PMD will fall (point B).

Mathematical constraints demand it. Thus the patient who initially presents a high PMD and a high Overall score must follow Porch and Callaghan's "C" pattern as his Overall score improves. The "C" patterns found in our seven patients (Figure 2) can be explained on the basis of these mathematical constraints in six of the seven cases. Their PMD's were bound to fall as their Overall scores rose because their values were so close to the mathematical limits. Examination of Porch and Callaghan's (1981) data shows that their "C" pattern patients exhibit high initial PMD values in addition to their high Overall scores when compared to their "F" pattern patients (See Figure 4). Thus their "C" pattern patients were closer to the mathematical limit than their "F" pattern patients. This raises the question as to whether many of the patients in Porch and Callaghan's study who manifested a "C" pattern did so as a function of mathematical constraints. Because of their lower PMD's and lower Overall scores their "F" pattern patients were not similarly constrained. A patient manifesting a lower Overall PICA score and a lower PMD (point A' in Figure 5) needn't follow a "C" pattern. The PMD can rise or fall as the Overall score rises. If the PMD rises (A' to B'), an "F" pattern results. If the Overall score continues to rise (B' to C') the PMD must then fall ("C" pattern). Two of our patients (Figure 3) manifested "F" patterns which changed to "C" patterns (Subjects R.F. and D.H.), one showed an "F" pattern (Subject G.H.), and the remaining three patients showed no identifiable pattern.

The mathematical limits of the PMD as presented in Figure 5 also have implications for the results presented by Aten and Lyon (1978). We agree with Porch and Calalghan (1981) that it is not surprising that such poor correlations between PMD and amount of change in PICA Overall scores were obtained when both "C" and "F" patterns are present in the sample, because these two patterns represent decreasing and increasing values, respectively. Porch and Callaghan attribute these poor correlations to mixing two different groups of patients with regard to site of lesion, hence both "C" and "F" patterns were present. However, we feel that the "C" and "F" patterns instead may reflect the range of initial PICA Overall scores in their sample. If some of their patients began with high Overall scores and relatively high PMD's they would have to show a "C" pattern whereas patients who began with lower Overall scores might yield either "C" or "F" patterns.

In the final analysis, the wisdom of using the PMD as an index of potential for recovery must be questioned. First, it is subject to the mathematical constraints previously discussed. Second, a change in its value is not directly interpretable. A rise in PMD may be caused by a rise in peaks or by a fall in means. Conversely, a fall in PMD may be caused by a fall in peaks or by a rise in means. It is meaningless to attempt to interpret changes in the PMD over time without consideration of changes in Overall scores. The real value of the PMD is not because it measures variance, but because it reflects a difference between the patient's potential (peaks) and the patient's performance (means). The peak score reflects the highest level at which the patient can function qualitatively, not just quantitatively. The mean reflects his actual level of function (Porch, 1981). To take this information and put it in terms of PMD's merely obscures it. A direct consideration, then, of peaks and means, while providing no information additional to that provided by the PMD, gives the clinician that information in a more interpretable form.

By graphing peaks and means by modalities (verbal, gestural, graphic), or by subtests, the clinician could perhaps better determine an approach to treatment. In a modality or task in which a discrepancy between means and peaks exists, emphasis might be placed on consistency of performance (raising means). In a modality or task in which the peak scores and the mean scores are close together, the emphasis might be placed on developing new skills (raising peaks).

As far as the prognostic value of looking at peaks and means directly goes, this much can probably be said: for any two patients with the same Overall PICA score, the one with the higher average peak score has the better prognosis.

CONCLUSION

Cases of aphasia due to blunt head injury manifest many different patterns of recovery in terms of change in PMD with change in Overall PICA scores over time. Those showing a pattern tend to do so only in response to mathematical constraints of the PMD. The use of the mean of the peaks and the Overall scores plotted over time seems to be more meaningful than the PMD. Such a representation provides information which may be useful in determining an approach to treatment. It may further have limited value in terms of prognosis.

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Q: Do you feel uncomfortable about using what I assume are bilaterally involved patients and comparing them to Porch's sample which, as I remember, was unilateral and also the Aten and Lyon sample which was unilateral?

A: I wasn't trying to compare bilaterals to the unilaterals. What I was saying is that the mathematical constraints of the PMD apply regardless of the patient population and these constraints can be used to interpret information on both bilateral and unilateral populations. What we did was to see if "C" and "F" patterns were meaningful in our bilateral population, and we found that they weren't exactly the same.

Q: Maybe PMD's are for determining focus in therapy but not for predicting the future?

A: Right. As we said, we think that the only real use for the PMD in predicting recovery is to say that if you have two patients who have the same Overall PICA score, the one with the higher peaks probably has the better prognosis. He's already performing certain skills that the other patient isn't. He's just not performing them consistently. Now, I really don't know if that would hold up statistically because we didn't investigate that.

Q: Did you throw out all tests that were all 15's? Because they wouldn't have any variability.

A: No. Those were included.

Q: Would a measure such as standard deviation be limited by similar constraints?

A: Yes, it would. The same sort of thing would apply. A person who has a high test score overall simply can't show you the variability that a patient with a lower test score can. If your test scores are going to average 14's or so it means you can't have a range of scores with a lot of 2's and 1's. Whereas, if your score is going to be a 5, let's say, you can have 15's and 2's all mixed together in there and show more variability.