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Metacarpophalangeal pattern profile analysis in Prader-Willi syndrome:

A follow-up report on 38 cases

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Abstract

Metacarpophalangeal pattern profile (MCPP) was determined on 38 Prader-Willi syndrome individuals and compared with a previous report on 16 patients. Chromosome analysis showed an interstitial deletion of the long arm of chromosome 15 in 20 subjects and norm al chromosome results in the remaining 18 individuals. The mean hand profile of 38 individuals was essentially flat while the profiles for the two groups based on chromosome findings were separate in the metacarpal area. Correlation studies confirmed the homogeneity of the deletion group relative to Prader-Willi syndrome individuals with normal chromosomes. Discriminant analysis of Prader-Willi syndrome versus control individuals produced a function of three MCPP variables plus age which may be applied as another diagnostic tool.

Keywords

Chromosome 15 deletion; correlation studies; discriminant analysis; metacarpophalangeal pattern profile (MCPP); Prader-Willi syndrome subgroups

Prader-Willi syndrome (PWS) is characterized by infantile hypotonia, early childhood obesity, mental deficiency, small hands and feet, hypogonadism and deletion of the proximal long arm in 50% of cases (Ledbetter et al. 1982, Butler & Palmer 1983). Diagnosis of the condition may be difficult, particularly in the younger patient. Therefore, quantitative methods based on clinical or physical attributes may be helpful. Hence, we report a follow-up study of the metacarpophalangeal pattern profile (MCPP) analysis of 38 individuals whose clinical features were consistent with PWS. Our initial report on PWS suggested that MCPP analysis may be useful as a diagnostic tool but additional testing was required (Butler et al. 1982).

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Material and Methods

Postero-anterior hand radiographis were obtained on 38 PWS patients consisting of 23 males and 15 females ranging in age from 0.2 to 38.5 years with a mean age of 12.2 years. The procedures for MCPP measurements, standardized Z score computations, correlation and discriminant analyses were described previously (Butler et al. 1982).

Results and Discussion

The mean pattern profile based on the 19 hand bones of 38 PWS individuals was essentially flat without obvious vertical deviations as reported previously with the 16 PWS individuals (Butler et al. 1982). The mean Z scores fell between −1.7 and −2.3; therefore, each hand bone was significantly shorter than normal at the 5% level. As reported in the original 16 patients, the distal hand bones were shorter than the proximal bones. The mean Z scores of the two groups of PWS individuals based on the chromosome results (15q deletion or nondeletion) showed two separate profiles, particularly for the metacarpals, but some overlap for the distal bones.

The Pearsonian r test to assess similarity between the individual patterns and their group mean revealed 14 of 20 members of the deletion chromosome group (Table 1) and seven of 18 nondeletion members (Table 2) with a significant correlation at the 5% level. Therefore, the deletion chromosome group was more homogeneous which contrasts with the heterogeneity of the nondeletion group. Homogeneity of the deletion group was also observed with dermatoglyphic patterns (Reed & Butler 1984).

A forward stepwise method of discriminant analysis of 41 control individuals and the original 16 PWS individuals, regardless of the chromosome findings, resulted in a discriminant function based on three (second metacarpal, fifth middle and distal phalanges) of the 19 hand bones plus age. All PWS patients were distinguished from the 41 control subjects (Butler et al. 1982). Therefore, 22 PWS individuals were used to test the method’s power to identify additional PWS patients. Twenty of the 22 additional individuals (91%) were classified as PWS based on the equation produced by the original discrimination of 16 PWS patients.

A stepwise discriminant analysis of all 38 PWS and 41 control individuals resulted in a correct classification rate of 96.2% (Figure 1). Two PWS individuals (both with deletions) and one control individual were misclassified. This discriminant function was based on three of the 19 hand bones plus age. The three MCPP variables in the discriminant function were the Z scores representing: (1) the fifth distal phalanx (X19), (2) the fifth middle phalanx (X14) and (3) the fifth metacarpal (X5). Therefore, all of the discriminating variables between the control and PWS individuals were of the fifth finger. On physical examination, it appeared that individuals with PWS have an overall small hand size and a short fifth finger in relationship to the other digits. The discriminant analysis results suggest that effective classification of PWS patients compared with control individuals based on MCPP data is possible and may be applied in a clinical setting as a diagnostic tool in the evaluation of patients of all ages in whom Prader-Willi syndrome is suspected.

Additional discriminant analyses of deletion (N = 20) and nondeletion (N =18) Prader-Willi syndrome groups resulted in a discriminant function based on two of the 19 MCPP variables plus age. The two variables comprising the discriminant function were the Z scores representing: (1) the second metacarpal (X2) and (2) the fifth distal phalanx (X15). Individuals with a chromosome deletion were distinguished from the individuals with normal chromosomes at an overall correct classification rate of 76.3%. Five deletion and four nondeletion individuals were misclassified. There was correct classification in all deletion and nondeletion PWS individuals in the original report (Butler et al. 1982). Therefore, the addition of 13 deletion and 11 nondeletion PWS individuals to our sample decreased the correct classification rate from 100 to 76%. By examination of MCPP data, deletion PWS individuals tend to have a greater hand length compared with nondeletion individuals. However, hand length in PWS individuals is generally smaller than in the general population.

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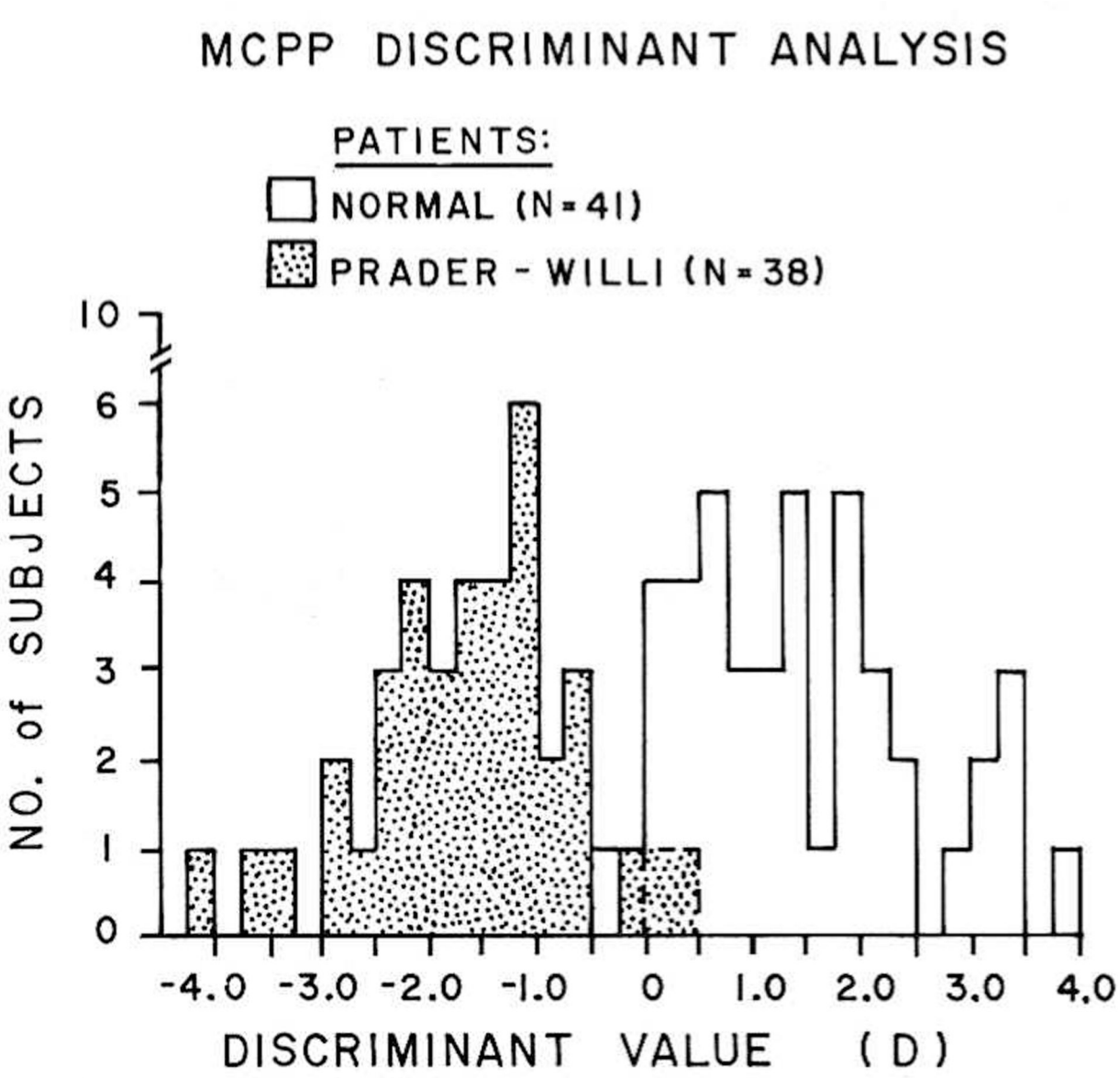

Fig. 1.

Histogram depicting normal and Prader-Willi syndrome classification by discriminant analysis. D = −0.29 −0.50 (X5) + 0.78(X14) + 0.76(X19) + 0.10 (age in years).

Table 1

Prader-Willi syndrome MCPP correlations

Chromosome 15 deletion	
Age (years)	**Individual's correlation with group mean**
Males	
1.2	0.64***
3.8	0.20
5.0	0.47*
8.7	0.75***
11.9	0.36
14.9	0.54**
17.1	0.62***
18.0	0.53**
18.4	0.70***
23.6	0.19
38.6	0.78***
Females	
0.2	0.61***
4.9	−0.08
5.8	0.15
10.7	0.56**
13.1	0.18
16.5	0.45*
17.6	0.57**
20.1	0.83***
22.8	0.76***

* $p < 0.05$

** $p < 0.01$

*** $p < 0.005$

Table 2

Prader-Willi syndrome MCPP correlations

Normal chromosome 15	
Age (years)	**Individual's correlation with group mean**
Males	
1.5	0.16
2.0	0.41*
3.3	0.34
4.0	0.11
5.6	0.37
7.2	0.41*
10.6	0.04
11.9	0.45*
15.8	0.69***
17.0	0.67***
19.8	0.42*
23.6	0.38
Females	
2.4	−0.06
6.6	0.34
12.7	0.24
13.8	0.41*
14.7	−0.10
16.5	0.30

* $p < 0.05$

** $p < 0.01$

*** $p < 0.005$