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Dermatoglyphic characteristics of digito-palmar complex in autistic boys in Serbia

Dermatoglifske karakteristike digitopalmarnog kompleksa kod autističnih dečaka u Srbiji

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Abstract

Introduction/Aim. Dermatoglyphics is a science that examines dermal patterns on volar side of both palms and soles. Since dermatoglyphs are unique for each person, by examining them a number of parameters can be determined. These parameters could help to diagnose and treat examined individulas. The aim of this study was to determine possible differences of the dermathoglyphic characteristics of digito-palmar complex (DPC) comparing the autistic boys with the healthy examinees. **Methods**. This study was conducted on a group of 182 boys with infantile autism, aged from 5 to 15 (average age 7.2 years) while the control group consisted of 182 healthy men from 30 to 50 years (average age 38.7 years). Within the digital scope of DPC we examined tree types of dermatoglyphic patterns on fingertips (arch, loop and whrol), as well as dermal ridge count on each finger separately (FRC – finger ridge count) and total dermal ridge count on all the ten fingers (TRC – total ridge count). Within the palmar DPC area we measured the angles between the triradius (atd, dat, adt, atb, btc, ctd), as well as dermal ridge count (RC – ridge count) between the triradius a-b, b-c and c-d. **Results.** The autistic boys had a significantely higher count of arches (9.17%) on fingertips of both hands when compared to the control group of examinees (4.34%), and the lower count of loops (28.40%) compared with the control group (32.42%). A higher count of arches was especially expressed on the fourth and fifth finger of both hands. Beside this characteristic, the autistic boys had a lower TRC and ab-RC as well as a wider atd angle. **Conclusion.** Dermatoglyphic analysis could help in diagnosing autism but only as an additional method, never as a dominant diagnostic procedure.

Key words:
dermatoglyphics; autistic disorder; child; fingers; hand; diagnostic techniques and procedures; sensitivity and specificity.

Apstrakt

Uvod/Cilj. Dermatoglifika je nauka koja se bavi proučavanjem dermalnih šara (dermatoglifa) na volarnoj strani šaka i tabanima. Pošto su dermatoglifi specifični za svaku osobu njihovim proučavanjem mogu se utvrditi brojni parametari koji olakšavaju dijagnostikovanje i lečenje ispitivanih osoba. Cilj istraživanja bio je da se utvrde moguće razlike u dermatoglifskim karakteristikama digitopalmarnog kompleksa (DPK) kod autističnih dečaka i zdravih osoba. **Metode.** Ispitivanje je obuhvatalo 182 dečaka sa infantilnim autizmom, uzrasta 5–15 godina (prosečno 7,2 godine), i kontrolnu grupu od 182 zdrava muškarca, stara 30–50 godina (prosečno 38,7 godina). U okviru digitalnog dela DPK ispitivali smo tri vrste dermatoglifskih obrazaca na jagodicama prstiju (luk, petlju i spiralu), kao i broj dermalnih grebena na svakom prstu posebno (FRC – *finger ridge count*) i ukupan broj dermalnih grebena na svih deset prstiju (TRC – *total ridge count*). Kod palmarnog dela DPK merili smo uglove između triradijusa (atd, dat, adt, atb, btc, ctd), kao i broj dermalnih grebena (RC – *ridge count*) između triradijusa a-b, b-c i c-d. **Rezultati.** Autistični dečaci imali su znatno veći broj lukova (9,17%) na jagodicama obe šake u odnosu na ispitanike kontrolne grupe (4,34%), ali manji broj petlji (28,40%) od kontrolne grupe (32,42%). Veći broj lukova bio je posebno izražen na četvrtom i petom prstu obe šake. Pored ove karakteristike autistični dečaci imali su niži TRC i ab-RC kao i veći atd ugao. **Zaključak.** Dermatoglifska analiza može biti od pomoći za dijagnostikovanje autizma kao pomoćna metoda, ali nikako kao dominantna dijagnostička procedura.

Ključne reči:
dermatoglifika; autistički poremećaj; deca; prsti; šaka; dijagnostičke tehnike i procedure; osetljivost i specifičnost.

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Introduction

Clinical dermatoglyphics is a science that studies dermal patterns (dermatoglyphs) on the volar side of hands and soles. Dermatoglyphs are unique for each person, therefore studying them can determine a number of parameters which could be helpful in diagnosing and treatment of examined individuals. The term 'dermatoglyphs' for dermal lines, was used for the first time by American scientists Cummins and Midla in 1926. In the same year the National Congress of American Anatomist and Morphologist officially verified dermatoglyphics as a branch of medical science.[1] In Serbia, clinical dermatoglyphs appeared in XX century, during the 50-ies and the first significant study on this area was the Doctor's Dissertation of Krstić [2]. After these pioneering attempts in Serbia there were over 20 master theses and PhD dissertations related to dermatglyphs.

Today, by using clinical dermatoglyphics over 150 diseases could be identified with 80% to 99.9% of probability. Clinical dermatoglyphics is most often used in diagnosing mental retardation [3, 4], autism [5], schizophrenia [6], Alzheimer' diseases [7], or even in predicting appearances of addiction diseases such is alcoholism [8]. Besides mentioned above, dermatoglyphs can be used to determine genetic predispositions for dyslexia [9], or hyperactivity [10], and also as clinical markers for various types of trisomy.[11] Dermatoglyphic markers of autistic patients have been poorly studied in scientific literature, therefore a very few number of researchers dealt with this problem. Because of the lack of papers on this area and nonexistence of similar researches in Serbia, we decided to conduct this research in order to determine possible differences in dermatoglyphic characteristics of the digito-palmar complex (DPC) among autistic boys and healthy population.

Methods

The research included 182 boys with autism who were on rehabilitation program in the Institute for Psychophysiological Disorders and Speach Patology "Prof. Dr. C. Brajović", in Serbia and in the Cabinet for Defectology "Stošljević" in Serbia. Testing was carried out during the period from 2005 to 2010.

To identify and classify dermatoglyphs, for taking DPC prints, we decided to use the digital scaning method in accordance with the protocols of Cummins and Midlo [12] and Penrose [13]. Dermatoglyphs of the palmar area were determined using a classical scanner type "Canon" (CanoScan 9000F, 4800 × 4800 dpi Resolution) and the software for image editing "VectorMagic" (Figures 1 and 2). Dermatoglyphic fingertip patterns of the hand were determined using a specialized scanner (AET62 NFC, Advanced Card Systems, Ltd.), and the software "VeriFinger" that semiautomatically converts data from the natural into graphic shape (Figure 3).

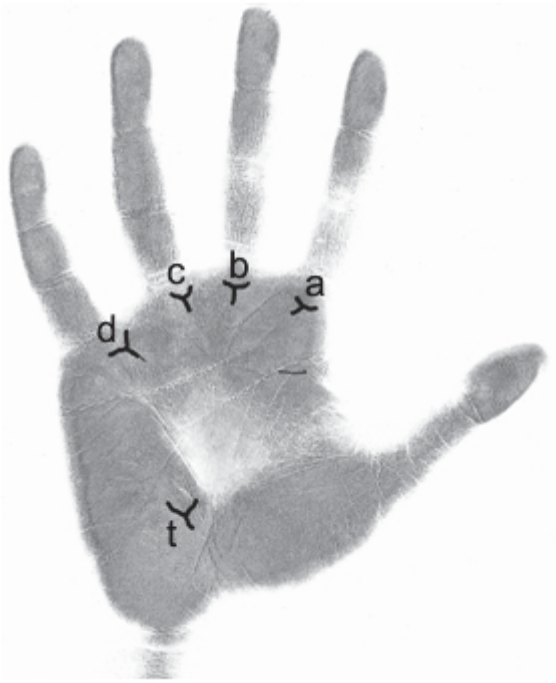

Fig. 1 – A digital hand print processed by "VectorMagic" software

Fig. 2 – An amplification of digital hand print on the level of a-b number

Natural print *Processed print*

Fig. 3 – A digital fingertip print processed by „VeriFinger" software

Qualitative-quantative analysis of the digital DPC area and quantitive analysis of the palmar DPC area were used to make a choice of variables. This implies that in the scope of digital DPC part we examined tree types of dermatoglyphic patterns on fingerprints (arch, loop and whorl) (Figure 4), as well as dermal ridge count on each finger separately (FRC – finger ridge count) and total dermal ridge count on all the ten fingers (TRC – total ridge count). At palmar DPC part we measured angles between the triradius (atd, dat, adt, atb, btc, ctd), as well as dermal ridge count (RC- ridge count) between the triradius a-b, b-c and c-d. Triradius is a spot, a point where three fields of nearly parallel lines meet. These fields form angles of 120° with each other and constrain three regions. It is important that the mutual angle of lines, of which triradius is made, must have at least 90°, so that we can talk about triradius in general. Figure 1 shows triradius a, b, c, d and t which, when connected, form above mentioned dermatoglyphic markers.

Fig. 4 – A type of dermatoglyphic patterns on the top of hand's fingertips

The results obtained by qualitative analysis are descriptively presented through absolute numbers and percentages, while the quantitative analysis results are compared using the Student *t*-test in SPSS (version 17.0.) program. The values of $p \leq 0.05$ were considered significant.

Results

The autistic examinees were from 5 to 15 years old (average age 7.2 years). Besides autism, diagnosed according to the DSM-IV classification, 32.8% examinees had profound intellectual disability (IQ below 34) combined with anxiety and incontinence, while 52.49% examinees had mild intellectual disability (IQ 35–50) followed with alalia and hyperacusis. The rest of examinees (14.64%) were in the light intellectual disability category (IQ 51–70) accompanied by echolalia and stereotypic movement disorder. Epilepsy was diagnosed in 9.56% of the examinees. The control group consisted of 182 healthy men, 30–50 years old (average age 38.7 years). Since dermatoglyphic characteristics do not change during a life time, the equalization of groups by age was not necessary.

Qualitative analysis of digital dermatoglyphic patterns implies determinating type and count of dermatoghlyphic patterns on fingertips of hands. The results of this analysis are shown in Table 1. The autistic boys, compared with the control group (4.34%), had significantly higher arch count (9.17%) on fingertips of both hands, and the lower loop count (28.40%) than the control group (32.42%).

Table 1

The results of quantitative digial dermatoglyphic pattern analysis in the autistic boys (A) and the control group (C)

Group type	Whorl		Loop		Arches	
	n	%	n	%	n	%
			The right hand			
A	595	65.38	228	25.05	87	9.56
C	604	66.37	268	29.45	38	4.17
			The left hand			
A	541	59.45	289	31.75	80	8.79
C	547	60.10	322	35.38	41	4.50
			Both hands			
A	1136	62.41	517	28.40	167	9.17
C	1151	63.24	590	32.42	79	4.34

Quantitative DPC analysis implies statistical comparison of numeric values gained from dermal ridge count and measurement of the angles between the triradius. The results of quantitave analysis of digital DPC area in the autistic boys and control group are shown in Table 2, indicating that statistical significance appeared for FRC variables of the fourth and fifth finger of both hands ($p < 0.05$), as well as for variables of dermal ridge count on five fingers of the right hand ($p < 0.001$) and the left hand ($p < 0.01$). A significant difference was also determined for TRC variable ($p < 0.001$).

The results of quantitative palmar DPC area analysis of the autistic boys and the control group are shown in Table 3 indicating that statistical significance appeared for atd angle variable ($p < 0.05$) and for ab number ($p < 0.05$) of both hands. No statistical significance was determined for other examined variables.

Table 2.

The results of quantitative digital digito-palmar complex (DPC) area analysis in the autistic boys and the control group

Localization of dermal ridges		Autistic boys group mean ± SD	Control group mean ± SD	*p*
The right hand	1st finger	18.98 ± 3.16	18.54 ± 2.84	> 0.05
	2nd finger	11.85 ± 2.35	11.35 ± 2.89	> 0.05
	3rd finger	11.87 ± 2.41	12.36 ± 2.64	> 0.05
	4th finger	14.15 ± 2.87	16.43 ± 2.93	< 0.05
	5th finger	11.27 ± 2.83	13.82 ± 2.98	< 0.05
	Total	68.12 ± 3.99	72.50 ± 4.01	< 0.001
The left hand	1st finger	19.45 ± 3.18	18.94 ± 3.76	> 0.05
	2nd finger	10.38 ± 2.96	10.80 ± 2.94	> 0.05
	3rd finger	13.02 ± 2.74	12.89 ± 3.12	> 0.05
	4th finger	12.31 ± 2.24	14.02 ± 2.83	< 0.05
	5th finger	12.32 ± 3.12	13.04 ± 2.32	< 0.05
	Total	66.38 ± 3.94	69.69 ± 4.06	< 0.01
Total count for ten fingers TRC (total dermal ridge)		134.90 ± 6.88	142.19 ± 6.03	< 0.001

Table 3

The results of quantitative digito-palmar complex (DPC) area analysis in the autistic boys and the control group

Type and localization of dermatoglyphic markers		Autistic boys group mean ± SD	Control group mean ± SD	*p*
The right hand	atd angle	46.20 ± 1.24	42.17 ± 1.25	< 0.05
	dat angle	58.79 ± 0.78	58.15 ± 0.72	> 0.05
	adt angle	82.25 ± 1.25	81.63 ± 1.23	> 0.05
	atb angle	15.97 ± 1.12	15.33 ± 0.95	> 0.05
	btc angle	12.83 ± 0.45	12.01 ± 1.13	> 0.05
	ctd angle	14.00 ± 0.66	13.28 ± 0.71	> 0.05
	a-b number	31.61 ± 0.92	34.61 ± 0.98	< 0.05
	b-c number	24.13 ± 0.84	25.75 ± 0.56	> 0.05
	c-d number	33.22 ± 0.89	34.88 ± 1.15	> 0.05
The left hand	atd angle	48.31 ± 1.65	43.06 ± 1.37	< 0.05
	dat angle	58.04 ± 0.83	58.87 ± 0.88	> 0.05
	adt angle	83.34 ± 1.15	82.21 ± 1.65	> 0.05
	atb angle	16.28 ± 1.12	15.72 ± 1.45	> 0.05
	btc angle	11.86 ± 0.85	11.27 ± 0.97	> 0.05
	ctd angle	14.18 ± 0.83	14.89 ± 1.01	> 0.05
	a-b number	32.93 ± 0.72	36.45 ± 0.88	< 0.05
	b-c number	25.88 ± 0.69	25.59 ± 0.95	> 0.05
	c-d number	34.78 ± 1.73	33.34 ± 1.28	> 0.05

Discussion

It is known that skin and brain are forming from the same ectoderm, and therefore dermatoglyphic markers could give us specific information about early brain development disorder in autistic patients. Finger dermatoglyphics and the volar side of the hand are formed at the end of the first and within the second trimester of fetal development, so it seems that during that period of time, brain disorder development can occur [14]. Namely, it is a critical period in etiology of autism and other neurodevelopment disorders. In addition to this claim, a research of Courchesne [15], on autistic patients identified agenesis of the superior olive, dysgenesis of the facial nucleus, reduced numbers of Purkinje neurons, hypoplasia of the brainstem and posterior cerebellum, and increased neuron-packing density of the medial, cortical and central nuclei of the amygdala and the medial septum. As neurogenesis occurs for these different neuron types during approximately the fifth week of gestation, the possibility is raised that this may be a 'window of vulnerability' for autism; the likely etiologic heterogeneity of autism suggests that other windows of vulnerability are also possible.

By comparing qualitative and quantitative analysis of digital DPC area it was possible to determine that autistic children had higher arch count on the fourth and fifth fingers of both hands, which is in accordance with Tarke and Barabolski [16]. A higher distribution of arches on the fourth and fifth fingers of both hands as a consequence had lower FRC on these fingers, hence lower TRC, because dermal ridges with this type of dermal patterns do not count as they do not have a Core point and delta. In his research Walker [17] got similar results. He determined that autistic population has lower dermal ridge count, not only on the fourth and fifth fingers of both hands, but for all dermal ridge counts including the palmar DPC area. Quantitative analysis of palmar DPC area showed that autistic boys had a lower a-b RC

as well as a wider atd angle on both hands, and Bujas-Petkovic got these same results [18].

The more complex researches on this area, confirming the findings of our work, dealt with the relation between dermatoglyphs and family anamnesis. That research confirmed that autistic individuals were significantly different from healthy control group, in RC on fourth and fifth fingers, in a-b RC and also in atd angles of both hands. Healthy fathers of autistic patients had different atd angles, brothers of autistic patients were different in palms variations compared with healthy control group examinees. Mothers of autistic patients as compared with healthy control group examinees, were significantly different in RC on the first, fourth and fifth fingers, in a-b and c-d RC on palms and in atd angles of both hands [5].

In addition to this research we certainly have to add the results that were obtained by Arrieta et al. [19], which also confirmed that autistic children have a lower TRC and a wider atd angle, so, it is concluded that the obtained results do not contradict the hypothesis that genetic factors might be significant in etiology of unknown origin autism.

Of course, there are researchers who completely negate the value of dermatoglyphic analysis in diagnosing autism [20], as well as researchers who show a difference in dermatoglyphic findings between autistic and healthy population, but that difference is not enough for dermatoglyphic analysis to be considered as efficient analysis [21].

Conclusion

The results of our study show that the autistic boys as compared with the healthy examinees, had higher arch count on the fourth and fifth fingers of hands, lower TRC and a-b RC as well as wider atd angle. Thus, we consider dermatoglyphic analysis helpful in diagnosing autism, but only as an additional method and never as a dominant diagnostic procedure.

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