

## EFFECT OF REMEDIATION OF DICHOTIC LISTENING ABILITY IN ARABIC DYSLEXIC CHILDREN

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### ABSTRACT

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**Background:** Developmental dyslexia (DD) is a specific learning disability manifested by difficulties in learning to read and write despite of having adequate cognitive ability, motivation, access to instruction and intact peripheral sensory mechanisms. Dyslexia affects about 5%-10% of the child population.

**Aim of the work:** Evaluate the effect of computer-based remediation program on dichotic listening ability in dyslexic children.

**Patients and Method:** Study population included 30 dyslexic children who received central auditory training on dichotic listening ability 2sessions/week for 8 weeks, each session lasted for 30 minutes for two months. Each child underwent: Full history taking, Modified Arabic Dyslexic Screening Test (MADST) and Basic audiological evaluation. Central auditory processing questionnaire for children and Arabic Dichotic Digit test (DDT) were done pre- and post-remediation program.

**Results:** Using the DDT, 90% of study population had dichotic listening deficit. Central auditory questionnaire showed all abilities were affected and mostly affected abilities were attention, scholastic achievement and behavior. Central auditory questionnaire pre- & post- remediation results revealed subjective improvement following Dichotic listening remediation on dyslexic children. DDT pre & post remediation results relieved significant improvement following dichotic listening remediation program.

**Conclusion:** Remediation of dichotic listening ability had effect on dyslexic children and this was obvious on Dichotic digit test pre & post-remediation program. Subjective improvement measured by pre & post remediation results of central auditory questionnaire of children was mostly in attention, memory and scholastic achievement.

**Keywords:** Dyslexia, Central auditory processing disorders.

### INTRODUCTION:

Dyslexia is a specific reading disorder that is characterized by difficulty in reading, learning, gross neurological deficits, uncorrected visual or auditory problems, emotional disturbances and inadequate schooling<sup>(1)</sup>. Dyslexic children about 5–17% of the population and boys are usually more susceptible than girls<sup>(2)</sup>. Children with

dyslexia experience auditory processing deficit that interferes with their perception of the rhythmic timing of speech<sup>(3)</sup>. Children with reading difficulties have poorer responses than their age-matched peers with typical reading skills in clinical tests such as Frequency Pattern Test (FPT), Dichotic Digit Test (DDT), Gaps in Noise (GIN) and speech in noise<sup>(4)</sup>.

In school-aged children, central auditory processing disorders (CAPD) have attracted considerable interest because of suspicions that they may lead to learning difficulties, especially affecting language and literacy. Poor scholastic performance indicating that the auditory deficits may be due to disruption of inter-hemispheric processing of auditory information, possibly due to delayed myelination<sup>(5)</sup>.

Auditory processing disorders are deficits in the information processing of audible signals not attributed to impaired hearing sensitivity or intellectual impairment. Specifically (C) APD refers to limitations in the ongoing transmission, analysis, organization, transformation, elaboration, storage, retrieval and use of information contained in audible signals<sup>(6)</sup>.

Management of Auditory processing disorders (APD) is based mainly on three lines, direct skill remediation for the affected abilities, use of compensatory strategies and acoustic modification of the listening conditions<sup>(7)</sup>. Application of computer based training program for remediation of auditory processing deficit in learning disabled children may help those children to overcome their disabilities<sup>(8)</sup>. Therefore, this work was designed to apply a computer based remediation program dichotic listening task and evaluate the improvement in dyslexia symptoms.

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#### **AIM OF THE WORK:**

Evaluate the effect of computer-based remediation program on dichotic listening ability in dyslexic children.

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#### **PATIENTS AND METHODS:**

**Study setting:** At Audiology Unit, ENT Department, Ain Shams University.

**Study period:** From July 2019 to March 2020.

**Study population:** 30 children diagnosed as having dyslexia. They were chosen from Phoniatic Unit, ENT department, Ain Shams University.

**Inclusion criteria:** children diagnosed with dyslexia, age ranged 6 from 12 years, with normal hearing and average I.Q.

**Exclusion criteria:** Children with middle ear diseases, developmental or neurological diseases.

#### **Methods:**

Each child underwent: Full history taking, Modified Arabic Dyslexic Screening Test (MADST), Basic audiological evaluation, Central auditory questionnaire of children<sup>(9)</sup>, Arabic Dichotic Digit Test<sup>(10)</sup> and Arabic computer-based remediation program<sup>(10)</sup>: training on the dichotic listening ability was done two sessions / week each session lasted for 30 minutes for 2 months at central auditory clinic in El-Demerdash hospital . They were evaluated by central auditory questionnaire for children and Dichotic Digit Test (DDT) pre& post-remediation program.

**Ethical consideration:** The protocol was ethically approved by the ENT department board, the research Ethical Committee, Faculty of Medicine Ain Shams University.

**RESULTS:**

Table (1): Age & gender of the study group:

AGE (yrs.)	Mean (SD)		8.6 (1.3)
	Range		6-11
Gender	Male	Number	24
		Percentage %	80%
	Female	Number	6
		Percentage %	20%

80% of the participants were male.

Table (2): Scores of different abilities of the central auditory questionnaire of study group:

Central auditory questionnaire scores		
<b>Identification &amp; Localization.</b>	Median (IQR)	100 (100 – 100)
<b>Sustained &amp; selective Attention.</b>	Median (IQR)	25 (25 – 50)
<b>Audio-visual Integration.</b>	Median (IQR)	100 (50 – 100)
<b>Memory</b>	Median (IQR)	50 (25 – 50)
<b>Scholastic-achievement.</b>	Median (IQR)	37.5 (25 – 75)
<b>Language.</b>	Median (IQR)	50 (50 – 100)
<b>Behavior.</b>	Median (IQR)	40 (40 – 60)
<b>Total score</b>	Median (IQR)	54.64 (42.14 – 65)

All abilities of central auditory processing questionnaire were affected. The most affected abilities were attention, behavior and scholastic-achievement.

Table (3): Dichotic Digit Test (DDT) results of study group:

DDT (Version I)					
Age group	No. of children	Right ear		Left ear	
		Normal	Abnormal	Normal	Abnormal
6-8	14	8 (57%)	6 (42.8)	7 (50%)	7 (50%)
>8-10	15	8 (53.3%)	7 (46.6%)	13 (86.6%)	2 (13.3%)
>10-12	1	1 (100%)	0 (0%)	1 (100%)	0 (0%)
DDT (Version II)					
Age group	No. of children	Right ear		Left ear	
		Normal	Abnormal	Normal	Abnormal
6-8	14	2 (14.2%)	12 (85.7%)	2 (14.2%)	12 (85.7%)
>8-10	15	3 (20%)	12 (80%)	1 (6.6%)	14 (93.3%)
>10-12	1	0 (0%)	1 (100%)	0 (0%)	1 (100%)

Dichotic digit results showed that version I was normal in most of children, version II scores 80% had abnormal right ear scores and 90% had abnormal left ear scores

Table (4): Comparison between DDT results of study group & norms:

DDT (Version I)						
Age group	Study group		Norms		p-value	
	Right ear	Left ear	Right ear	Left ear	Right ear	Left ear
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)		
6-8	90 (10)	81.8 (14.5)	93.2 (3.2)	87.4 (12.6)	0.039(S)	0.062(NS)
>8-10	92 (7)	92 (8)	94.3 (5.7)	89.3 (7)	0.220(NS)	0.121(NS)
>10-12	100 (0)	95 (0)	98 (4.5)	97.3 (6.7)	0.017 (S)	0.064 (NS)
DDT (Version II)						
Age group	Study group		Norms		p-value	
	Right ear	Left ear	Right ear	Left ear	Right ear	Left ear
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)		
6-8	87.3 (12)	64 (17)	88.6 (6.4)	80 (7)	0.546(NS)	<0.001(HS)
>8-10	77.8 (16)	76 (9.5)	91.5 (7)	84.6 (6.8)	<0.001(HS)	<0.001(HS)
>10-12	90 (0)	90 (0)	95.8 (6.5)	92.3 (5.4)	<0.001(HS)	0.022 (S)

Norms of central clinic, Audiology Unit, Ain shams University was used.

There were significant differences between DDT (version II) results & norms.

Table (5): Results of Central auditory questionnaire for children of study group (pre & post-remediation):

	Study group		Test value	P-value	Sig.	
	Pre-remediation	Post-remediation				
<b>Questionnaire</b>						
<b>Identification &amp; Localization.</b>	Median (IQR)	100 (100 – 100)	100 (100 – 100)	-1.000≠	0.317	NS
<b>Sustained &amp; selective Attention.</b>	Median (IQR)	25 (25 – 50)	50 (25 – 87.5)	-2.392≠	0.017	S
<b>Audio-visual Integration.</b>	Median (IQR)	100 (25 – 100)	100 (62.5 – 100)	-1.604≠	0.109	NS
<b>Memory</b>	Median (IQR)	50 (25 – 50)	50 (50 – 87.5)	-3.125≠	0.002	HS
<b>Scholastic achievement</b>	Median (IQR)	50 (12.5 – 75)	75 (37.5 – 100)	-2.588≠	0.010	S
<b>Language</b>	Median (IQR)	50 (50 – 100)	75 (50 – 100)	-1.342≠	0.180	NS
<b>Behavior</b>	Median (IQR)	40 (30 – 60)	60 (40 – 80)	-1.841≠	0.066	NS
	Range					
<b>Total score</b>	Median (IQR)	57.14 (45 – 67.5)	70 (58.57 – 82.86)	-3.416≠	0.001	HS

There were statistically significant differences in (attention, memory, scholastic - achievement and total score of the questionnaire) between pre & post remediation.

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Table (6): DDT results (Version I & II) pre & post-remediation of study group:

DDT			Mean	SD	Range	P- Value	Sig.
Version (I)	Rt.	Pre	88.5	11.7	50-100	0.035	S
		Post	97	2.4	85-100		
	Lt.	Pre	86.5	13.1	55-100	0.021	S
		Post	95.5	4.3	75-100		
DDT Version (II)	Rt.	Pre	73.3	17.2	37.5-97.5	0.005	HS
		Post	89.5	8.5	67.5-97.5		
	Lt.	Pre	73	13.1	45-90	0.015	S
		Post	83.5	10.9	57.5-95		

There were statistically significant differences for the DDT results version (I & II) of both ears between pre & post-remediation.

### **DISCUSSION:**

Thirty dyslexic children with normal hearing of both genders were evaluated in this study. With the mean age was  $8.6 \pm 1.3$  & 80% of study group were male (**table 1**). The results of present study agreed many researches who mentioned that male sex predominance in dyslexic children<sup>(11,12 & 13)</sup>.

In the present study central auditory questionnaire revealed that all the abilities of central auditory processing questionnaire for children were affected and mostly affected abilities were attention, scholastic-achievement and behavior (table 2). The present study results agreed with **Elwan et al** who concluded that mostly affected abilities were attention, memory and scholastic- achievement in children with reading disability after applying the central auditory questionnaire<sup>(14)</sup>.

The present study showed high comorbidity of dyslexia with central auditory processing disorders (CAPD) (90% of study group had abnormal dichotic listening ability) (**table3, 4**). The present study results agreed with **Deborah & jeffrey** who reported that most of dyslexic

children (67%) demonstrated clinically significant left ear weaknesses on the Dichotic Digit Test (DDT)<sup>(15)</sup>. Auditory processing disorders assessment may help delineate factors that are associated with reading impairment in this population. Therefore, remediation of the affected abilities of central auditory processing in dyslexic children was highly recommended to enhance the improvement of dyslexic children symptoms.

The present study relieved subjective improvement following dichotic listening remediation as showed by central auditory questionnaire results pre& post remediation program in most of abilities (attention, memory and scholastic-achievement) (**table 5**).

Marked improvement after remediation program relieved by psycho-physical assessment DDT pre& post remediation program (**table 6**). The present study results showed high impact of dichotic listening remediation on dyslexic children following remediation program.

The present study results agreed with **Weihing** results who reported improvement of questionnaire respondents in the abilities (follow directions, communication ability, academic performance, attention and ability to hear in noise). Additionally he reported a significant improvement in pre- versus post training dichotic listening scores.

Improvements in dichotic processing also appeared to be related to a reduction of everyday symptoms of dyslexic children as determined by parent or teacher reports<sup>(16)</sup>.

The present study results agreed with **Moncrieff & Wertz** who trained the children for 30 minutes per session, three sessions a week, for 4 weeks and showed that left ear performance for dichotic digits improved significantly following training<sup>(17)</sup>.

The results of present work agreed with that of **Musiek et al** who used dichotic interaural intensity difference (DIID) to children with dichotic listening deficit and reported improve weaker ear performance over time. The lag between the two ears was gradually decreased and improved binaural hearing with all of its benefits to those children<sup>(18)</sup>.

#### **Conclusions:**

There was high comorbidity of dyslexia and dichotic listening deficit. 90% of study group had dichotic listening deficit. Central auditory processing remediation (dichotic listening remediation) had high impact on improvement of dyslexic children and this was obvious subjectively and objectively.

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العنوان: تأثير البرنامج العربي العلاجي المعتمد على الكمبيوتر على قدره الاستماع ثنائي التفرع في الاطفال الذين يعانون من عسر القراءة

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**المقدمة:** عسر القراءة النمائي هو عجز تعلم محدد تتجلى فيه الصعوبات في تعلم القراءة والكتابة على الرغم من وجود القدرة الإدراكية الكافية ، والحافز ، والوصول إلى التعليم ، والآليات الحسية الطرفية السليمة. من المقبول على نطاق واسع أن العجز في المعالجة الصوتية يكمن في ضعف أداء القراءة لدى غالبية الأفراد المصابين بعسر القراءة . يؤثر عسر القراءة على ٥% - ١٠% من عدد الأطفال. وتقدر بعض الدراسات إلى ٥% و ١٧% من الأطفال في سن الدراسة. ولذلك يمثل مشكلة صحية عامة كبره

**هدف البحث:** دراسته تأثير البرنامج العربي العلاجي المعتمد على الكمبيوتر على قدره الاستماع ثنائي التفرع في الاطفال الذين يعانون من عسر القراءة

**المرضى والطريقة:** مجتمع الدراسة: شمل ٣٠ طفلاً تم تشخيصهم على أنهم يعانون من عسر القراءة. تم اختيارهم من وحدة التخاطب عين شمس. تم تقييمهم من خلال استبيان المعالجة السمعية المركزية للأطفال و اختبار الارقام المتلاحمه قبل وبعد العلاج. تلقوا الاطفال تدريباً سمعياً مركزياً على القدرة على الاستماع ثنائي التفرع جليستين في الاسبوع لمدة ٨ أسابيع ، كل جلسة تستمر لمدة ٣٠ دقيقة لمدة شهرين. خضع كل طفل لما يلي: أخذ التاريخ الكامل ، اختبار فحص عسر القراءة العربي المعدل ، التقييم السمعي الأساسي ، الاستبيان السمعي المركزي للأطفال ، اختبار اختبار الارقام المتلاحمه و برنامج العلاج المعتمد على الكمبيوتر: تم إجراء تدريب على القدرة على الاستماع ثنائي التفرع جليستين في الاسبوع لمدة ٨ أسابيع في عيادة السمع المركزية في مستشفى الدمرداش.

**النتائج:** تم تقييم ثلاثين طفلاً مصابين بعسر القراءة من خلال استبيان المعالجة السمعية المركزية للأطفال ، وكشف أن القدرات المتأثرة للمعالجة السمعية المركزية كانت في الأساس الذاكرة والانتباه والتحصيل الدراسي. ٩٠% من مجتمع الدراسة كان لديهم ضعف في الاستماع. أظهرت نتائج الاستبيان السمعي المركزي قبل وبعد العلاج تحسناً ذاتياً بعد علاج الاستماع ثنائي التفرع على الأطفال الذين يعانون من عسر القراءة بشكل رئيسي في الانتباه والذاكرة والتحصيل الدراسي. خففت نتائج المعالجة المسبقة واللاحقة لاختبار الارقام المتلاحمه من التحسن الملحوظ بعد برنامج علاج الاستماع الثنائي.

**الخلاصة:** إن علاج القدرة على الاستماع الثنائي كان له تأثير على الأطفال الذين يعانون من عسر القراءة وهذا واضح في اختبار الارقام المتلاحمه قبل وبعد العلاج. التحسن الذاتي الذي تم قياسه من خلال نتائج المعالجة السابقة واللاحقة للاستبيان السمعي المركزي للأطفال كان بشكل رئيسي في الانتباه والذاكرة والتحصيل الدراسي.