Introduction

Most patients with Apraxia of Speech (AoS) are also aphasic or dysarthric; only a few have a pure form of AoS. Every patient has a specific range of underlying deficits. According to us it is essential to differentiate the exact underlying deficits at individuals in order to give them tailor-made therapy. With adequate diagnostic materials it should be possible to differentiate the deficits. In Centre for Rehabilitation (University Medical Centre Groningen) we developed an instrument that differentiates AoS from aphasia (especially conduction aphasia) and dysarthria. This instrument also measures the degree of the symptoms and therewith can be used as a tool to evaluate therapy. Also it can be used as a basis for giving content to the therapy.

There is no consensus among researchers about the definition and the related symptoms: characteristics of AoS. Also there are different theories about the underlying deficit of AoS (see Den Ouden 2004 for an overview).

In our study we adopted the framework of McNeil (2002). Before planning and programming articulatory movements there is a phonological encoding process. This process involves the metrical frame generation (syllable number and stress pattern), the construction of the slots (phoneme number and order) and the segment selection and filling. Patients with a disorder on this level show signs of conduction aphasia, namely errors in stress patterns, phoneme errors, like substitutions, additions, omissions and errors in serial ordening.
After this phonological encoding process 3 phonetic motoric levels are distinguished:
1. Motor planning: at this level appropriate motoric adaptations are made on the basis of context. Adaptations are made because of phoneme environment (co-articulation) or the fact that the speaker wants to speack loudly or fast.
2. Motor programming: a set of muscle commands are structured before a movement sequence begins. Coordination of muscles, resonance, respiratory and phonation are of importance on this level.
3. Movement execution; physiological parameters as muscle tone, basic reflexes and mechanical stiffness are assigned to this level.
According to Mc Neill (2002) a deficit in motor planning (1) and motor programming (2) leads to AoS while a deficit on the movement execution leads to dysarthric speech (3). In line with this we concluded that AoS, dysarthria and conduction aphasia arise at different levels and thus it should be possible to come up with distinctive diagnostic criteria for these deficits. In this abstract we describe the onset of the development of such criteria.

Method

In table 1 the relevant subject data are provided

Table 1 Participants

Design diagnostic instrument

In the international literature we found a lot of symptoms that were attributed to AoS. However many of these symptoms are also observed within patients with dysarthria or aphasia, especially within patients with conduction aphasia. We therefore looked for symptoms of AoS that were not observed in patients with aphasia and dysarthria. (see table 2 for an overview).The list of symptoms that were exclusively found in patients with AoS formed the basis for our diagnostic instrument. With the diagnostic instrument we measure the presence of these symptoms. If one of these symptoms in a certain amount occur than it is assumed that AoS is the underlying deficit. The aim of the DIAS is to check all described symptoms (table 2), because we think that it is necessary to describe which symptoms of AoS are present and to what degree

Table 2 Diagnostic Instrument for AoS (DIAS)

Procedure

The subjects were tested with the pilot-version of the DIAS. All subjects were tested in one session. Reactions were tape- and video recorded. All reactions were scored. The differences between the scores of the different types of language-disturbed subjects were compared with non-parametric tests (Mann-Whitney U)

Results

In table 3 the comparison between the scores of the different language-disturbed groups are depicted. The control subjects scored at ceiling on all tests.

Table 3 Results of the between group analyses (Mann-Whitney test)

Between group analyses showed that patients with AoS score significant worser on the bucco facial task, the DDK and the initiation of the articulating words compared to the atactic dysarthric patients. We found also a significant difference between patients with AoS and patients with conduction aphasia. The patients with AoS made significantly more errors on the bucco facial task and showed a higher number of inconsequent realizations of individual phonemes.

In conclusion these results indicate that the Diagnostic Instrument for AoS (DIAS) can distinguish between patients with AoS, atactic dysarthria and conduction aphasia.

Discussion

This pilot-study revealed that the DIAS is able to distinguish between patients with AoS, atactic dysarthria and conduction aphasia. For now, these results are encouraging but not yet satisfactory. Therefore we made changes based on the results of this pilot. Currently we are validating this test. In order to be able to consider the severity of AoS we made some changes to the scoring system. In the final test we will make a separation between measuring the presence of symptoms that are exclusively found in patients with AoS and measuring the severity by scoring at a more detailed level. The adapted version of the DIAS is currently administered to 50 patients and a control group of 50 subjects for validation.

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Table 1

	AoS (n = 11)	AD and no obvious symptoms of AoS or aphasia (n = 4)	CA and no obvious symptoms of AoS or dysarthria (n= 3)	Control group (n=10)
Age , mean (range)	62 (36-79)	49 (30-64)	69 (59-78)	57 (50-67)
Gender	6m, 5w	3m, 1w	1m, 2 w	5m , 5w
Months post onset, mean (range	8,3 (1,5-25)	6,5 (2-12)	4 (2-6)	
Laesion site	ICVA (l), 10x HCVA (r), 1x	ICVA (brainstem), 2x MIB (cerebellum), 1x Atrophy/ ICVA (cerebellum), 1x	ICVA l, 2x HCVA l, 1x	

AD= Atactic dysarthria CA= conduction aphasia AoS= Apraxia of Speech

Table 2 Diagnostic Instrument for AoS (DIAS)

	Task	**Items**	**Symptoms exclusively linked to bucco facial apraxia**
a	Task for buccofacial movements	10 items	1.Struggle to position the articulators and 2. Improved execution by imitation
	Task	**Items**	**Symptoms exclusively linked to apraxia of speech (AoS)**
1	Articulation of individual consonants and vocals	15 consonants and 15 vocals	1. Inconsequent sound productions 2. Significantly more errors in consonants than in vocals
2	Diadockokinesis task	6 repeating and 6 alternating items of 3 syllabes or words	1. More difficulty in alternating syllabes than repeating syllables.
3	Articulation of words	66 items	1. Initiation problems 2. Intersyllabic pauses 3. Segmentation of consonant combinations 4. Effect of articulatory complexity

Table 3 Results of the between group analyses (Mann-Whitney test)

Tests `	Groups	Z-score	Significance
Buccofacial apraxia	AoS-AD	-2,649	p < 0,01
Diadochokinesis (DDK)	AoS-AD	-2,347	p < 0,05
Initiation problems	AoS-AD	-2,422	p < 0,05
Number of inconsequent realizations of individual phonemes	AoS-AD	-0,993	**p=0,320**
Buccofacial apraxia	AoS- CA	-1,975	p < 0,05
Diadochokinesis (DDK)	AoS - CA	-0,781	**p=0,435**
Initiation problems	AoS - CA	-1,891	**P=0,059**
Number of inconsequent realizations of individual phonemes	AoS - CA	-2,438	P < 0,05

AD= Atactic dysarthria CA= conduction aphasia AoS= Apraxia of Speech