



RCSLT RESOURCE MANUAL FOR COMMISSIONING AND PLANNING SERVICES FOR SLCN

DYSARTHRIA

Dysarthria Synthesis

1. Key Points

1. Speech and language therapists play a unique role in identification and assessment of children and adults with Dysarthria. The ability to diagnose the specific speech disorder, as well as retained communication abilities, is a unique skill of speech and language therapists.
2. Improved communication has an impact on literacy, social skills, peer relationships, self-confidence and behaviour.
3. Difficulties with communication are a predominant feature in reducing access to education, recreation, employment and social integration.
4. There are many underlying pathologies associated with the types of Dysarthria. Speech and language therapists are unique in being able to identify Dysarthria types, which indicates the most appropriate management schedule.
5. Assessment and advice is indicated as appropriate and desirable for all persons with Dysarthria. Reassessment is warranted on a regular basis to review communication requirements and revisit the appropriacy of therapy interventions and assisted communication.
6. Specialist assessment and advice relating to augmented communication should be available.
7. Approaches to reducing speech impairment have been found to be effective, with some Dysarthria types e.g. Lee Silverman Voice Therapy for persons with Parkinson's disease, computerised articulation programs with chronic non progressive Dysarthria.
8. There is evidence that some persons with non-progressive Dysarthria benefit, long after the initial insult, indicating the necessity for review and further therapy.
9. Advisory and educational programs for relatives and carers should be part of speech and language therapy services.
10. Persons with progressive dysarthria can benefit from techniques to improve intelligibility of speech as well as communication aids. Both require the unique contribution by the speech therapist to facilitate appropriate use.
11. Persons with dysarthria remain at risk as defined by the Mental Capacity Act (2005)./ Incapacity Act, Speech and Language Therapists are integral to assessing competence for consenting.

2. What is dysarthria?

The term ‘dysarthria’ refers to “a group of motor speech disorders resulting from a disturbance in neuromuscular control” (Palmer, 2005). Swigert (1997, cited in Palmer, 2005) identifies 5 systems which can be affected by dysarthria: respiration, phonation, resonance, articulation and prosody. Impairments can result from damage to the central or peripheral nervous system, leading to “weakness, slowing, incoordination, altered muscle tone, and inaccuracy of oral and vocal movements” (Palmer & Enderby, 2007). This produces speech with abnormal characteristics, which can be unintelligible to varying degrees.

Dysarthria can be developmental, due to brain damage pre or during birth, or acquired in later life. There is a general distinction in the literature between childhood (developmental) and adult (acquired) dysarthria. However, this is not a clear distinction, as developmental dysarthria tends to be stable and therefore by its nature persists into adulthood. Acquired dysarthria can be acquired in childhood, e.g. through traumatic brain injury (TBI). Therefore both adults and children can have either developmental or acquired dysarthria. The key difference is that acquired dysarthria generally follows a period of normal speech development, whereas developmental dysarthria is present from birth, and is therefore mediated by brain maturation, rapid physical growth, cognitive and psychosocial development, and the process of acquiring a sound production system (Morgan & Vogel 2006).

Another important distinction is between stable dysarthria, where the underlying cause of the dysarthria is unchanging, and progressive dysarthria, usually associated with progressive neurological disease, meaning that the speech symptoms change (usually deteriorating) over time.

The table below sets out the types of dysarthria and their causes, based on these key distinctions:

Table 1: Types of dysarthria and causes

	Developmental		Acquired	
	Stable	Progressive	Stable	Progressive
Childhood	Cerebral Palsy and other stable neurological conditions acquired in pre and perinatal period.	Dystrophy (childhood progressive disease)	Brain Injury (including traumatic such as head injury and non-traumatic such as stroke).	
Adult	Continuation from childhood of neurological condition.		Brain Injury (including traumatic such as head injury and non-traumatic such as stroke).	Multiple sclerosis, Parkinson’s disease, amyotrophic lateral sclerosis and other acquired neurological diseases.

3. How many people have dysarthria?

There are no known figures indicating the incidence of dysarthria in the general population, and “a dearth of information of the prevalence of dysarthria in children” (Pennington, Miller et al, 2008). The incidence and prevalence figures available have been collated into the tables below.

Table 2: Incidence and prevalence figures of dysarthria in children

Disorder	Specific disorder in general population		Dysarthria within the disorder		Referral for SLT
	Incidence	Prevalence	Incidence	Prevalence	
Traumatic brain injury	280 per 100,000 (Morgan A & Vogel A 2006)	1 out of 1500 per year (RCSLT 2006)	Not known	Not known	Not known
Cerebral Palsy	2 per 1000 live births (Hinchcliffe A 2003)	2-3 per 1000 (SCOPE 2006, cited in RCSLT 2006)	Not known	40-50% (Kennes 2002; Bax 2006, cited in Pennington L, Miller N, et al. 2008)	Not known

Table 3: Incidence and prevalence figures of dysarthria in Adults

Disorder	Specific disorder in general population		Dysarthria within the disorder		Referral for SLT
	Incidence	Prevalence	Incidence	Prevalence	
Traumatic brain injury	275 per 100,000 (BSRM & RCP, 2003, cited in RCSLT 2006)	100-150 per 100,000 severe (Royal Hospital of Neuro disability, cited in RCSLT 2006).	33% (Samo et al 1996, cited in Enderby P & Emerson J 1995))	Not known	Not known
Parkinson's Disease	17 per 100,000 (Parkinson's Disease Society 2006, cited in RCSLT 2006)	200 per 100,000 (Parkinson's Disease Society 2006, cited in RCSLT 2006)	70% (self reported) 50-90% (increasing incidence as disease progresses) (Pinto S, Ozsancak C, et al. 2004)	Not known	20% (Deane KHO, Whurr R, et al. 2001)

Disorder	Specific disorder in general population		Dysarthria within the disorder		Referral for SLT
	Incidence	Prevalence	Incidence	Prevalence	
Stroke	150,000 yearly in UK (The Stroke Association 2008))	250,000 in UK (The Stroke Association 2008)	20% (Enderby P & Emerson J 1995)	50% diminishing as recovery (RCSLT 2006)	Not known
Motor Neurone Disease	2 per 100,000 (MND 2004, cited in RCSLT 2006)	7 per 100,000 (MND 2004, cited in RCSLT 2006)	Not known	Not known	Not known
Multiple Sclerosis	4 per 100,000 (MS Society 2006, cited in RCSLT 2006)	144 per 100,000 (MS Society 2006, cited in RCSLT 2006)	Not known	Not known	Not known
Progressive neurological disorders	1% (Neurological Alliance 2003, cited in RCSLT 2006)	10 million in UK (Neurological Alliance 2003, cited in RCSLT 2006)	Not known	30-80% (RCSLT 2006)	Not known

4. What causes dysarthria?

Darley, Aronson and Brown (The Mayo clinic classification system 1969, cited in Murdoch, 1998) classified dysarthria according to the part of the nervous system which is implicated:

Table 4: Classification of dysarthria

Type	Part of nervous system implicated
Spastic	Upper motor neurones
Flaccid	Lower motor neurones
Mixed	Upper and lower motor neurones
Ataxic	Cerebellar
Hypokinetic	Extrapyramidal tract, substantia nigra
Hyperkinetic	Extrapyramidal tract, Basal ganglia,

Childhood dysarthria can range from so mild that it can be confused with a developmental articulation disorder, to so severe that speech is unintelligible. While classification of childhood dysarthria has traditionally reflected what is found in the adult population, childhood dysarthrias have the added complication of the interaction between acquired and developmental aspects of the disorder (Murdoch,1998), and therefore need their own classification system.

Developmental dysarthria is most commonly seen in children with cerebral palsy, a neurological condition caused by damage to the immature brain. Sub-types of dysarthria found within cerebral palsy have been described by Love & Webb (2001):

Table 5: Sub-types of dysarthria found within cerebral palsy

Type	Part of nervous system implicated
Spastic	Upper motor neurones
Dyskinetic (hypo or hyperkinetic)	Extrapyramidal tracts or basal ganglia
Ataxic	Cerebellar

5. How does dysarthria affect individuals?

Dysarthria varies in severity and symptoms depending on the types of dysarthria:

Table 6: Dysarthria severity and symptoms by type

Type	Features
Spastic	Strained and hoarse voice, hypernasality and slow imprecise articulation (Aronson 1993, cited in Palmer 2005). Often accompanied by swallowing and drooling difficulties (Palmer 2005).
Flaccid	Isolated areas of involvement depending on which motor neurone is affected (Enderby 1983, cited in Palmer R 2005).
Ataxic	Excess loudness, tremor and irregular articulatory breakdowns (Aronson 1993, cited in Palmer R 2005). Intonation, pitch and volume and also be affected (Enderby 1983, cited in Palmer 2005), as well as difficulty with alternate tongue movements.
Hypokinetic	Breathy monotone voice with reduced loudness (Enderby 1983, cited in Palmer 2005) and articulation tends to be accelerated and imprecise (Yorkston et al 1999, cited in Palmer R 2005).
Hyperkinetic	Features strained hoarseness and voice arrests.
Mixed	Similar symptoms to spastic dysarthria, and tends to be accompanied by a wet sounding voice with rapid tremor, poor laryngeal and tongue movements and poor control of lips (Enderby 1983, Aronson 1993, cited in Palmer 2005).

The common result of these symptoms is that the person with dysarthria has reduced intelligibility, making communication difficult. This can lead to difficulties with social interaction, employment and

education (Enderby & Emerson, 1995). Yorkston et al (1994, cited in Dickson et al, 2008) found that individuals with severe dysarthria were more likely to experience being laughed at, or ridiculed (Dickson et al, 2008). These authors sum up the psychosocial effects of dysarthria as follows: “Reduced communication skills as a result of dysarthria following a stroke can extend beyond the physiological to cause changes in self-identity, relationships, social and emotional disruptions and feelings of stigmatisation or perceived stigmatisation” (p8).

More than half of the participants with dysarthria in their study reported negative changes in self-identity resulting from their speech disorder. The reduced ability to communicate makes such adults vulnerable to social isolation.

It is important to note that degenerative dysarthria can lead to speech being completely non-functional (Yorkston, 2007).

In children a lack of an effective method of communication can lead to emotional and behavioural problems (RCSLT, 2006), and affects access to education and normal socialisation. This all adds to the impact on potential for later employment and participation in and contribution to society (Morgan & Vogel, 2006).

The potentially far reaching and long term effects of dysarthria mean that it needs to be treated in a timely and appropriate fashion, throughout the period that the individual is affected by it. If this does not happen it is likely to have a highly detrimental effect on the patient’s health and social well being, which is likely to have an ultimate cost to health and social care.

Table 7: International Classification of Functioning: dimension and impact of dysarthria

ICF dimension	Impact
Impairment	<ul style="list-style-type: none"> • Impaired muscle tone affecting power, precision and range of movement affecting oral, vocal and breathing movements. • Incoordination of the musculature for speech production results in abnormal speech characteristics e.g. misarticulated phonemes, altered voice quality/ tone/volume, altered resonance, nasal emission, lack of breath support.
Activity	<ul style="list-style-type: none"> • Reduced intelligibility of speech • Over-quiet voice • Reduced communicative ability • Burden of communication may rest on communicative partner
Participation	<ul style="list-style-type: none"> • Reduced communication skills can affect self-identity, relationships, and educational and employment. • Social participation and interaction disadvantages and restrictions

6. What are the aims/objectives of Speech and Language Therapy interventions for dysarthria?

The aims and objectives of speech and language therapy interventions for people with dysarthria will depend on the type and nature of the dysarthria, the underlying cause, and the communication needs of the individual. For people with milder dysarthria, the goal of therapy may be to improve the quality and naturalness of speech while maintaining intelligibility.

With children the focus of intervention is to maximise communicative potential, motivation to communicate and the creation of the correct environment to enable communication. For a person with severe dysarthria, the goal might be to have some degree of functional verbal communication (Enderby & Emerson, 1995), or to find non-speech based alternatives.

In summary, the role of the Speech and Language Therapist is “enabling an individual to achieve a mode of communication fitting to their age, gender, social circumstances and desires, within the limitations dictated by their neurological condition” (RCSLT, 2006)
Ensuring an appropriate environment for communication is essential, in all areas of life.

Table 8: International Classification of Functioning: dimension and techniques for intervention in dysarthria

ICF dimension	Techniques
Impairment	<p>normalisation of muscle tone and/or increasing strength of movement precision and co-ordination, (Pinto, Ozsancak , et al. 2004))</p> <p>Prosthetic methods for controlling some of the symptoms associated with dysarthria. Speech and language therapists will work all alongside medical and surgical colleagues in the assessment and monitoring of progress of any medical or surgical intervention.</p> <p>Behavioural techniques have the aim of “compensated intelligibility”, rather than “normal speech” (Deane, Whurr et al. 2001). Examples include: The Lee Silverman Voice Technique, “an intensive, high effort speech treatment designed to rescale the amplitude of motor output of speakers with PD dysarthria” (Pinto, Ozsancak et al. 2004).</p> <p>Dysarthria Treatment Programme (Drummond, Worley and Watson 2003, cited in Palmer & Enderby 2007)), is designed to target all speech processes simultaneously.</p>
Activity	<p>The use of devices and biofeedback giving feedback to enable patients to monitor and modify speech characteristics (Pinto, Ozsancak, et al. 2004)).</p> <p>Assistive devices can be used, ranging from the low-tech such as an alphabet board, to a high-tech computerised Augmentative and Alternation Communication systems. Voice amplifiers can be used to increase effectiveness of communication.</p> <p>Altering the environment can improve function (Sellars, Hughes, et al. 2005). E.g. ensuring that the listener has full view of the dysarthric speakers face (Palmer & Enderby 2007)). This approach puts responsibility onto the listener as well as the speaker, building effective communication.</p> <p>Speech and language therapists will work with the family, teachers, carers and others to ensure that approaches to improving communication (communication aids or vocal strategies) are incorporated in all situations.</p>

ICF dimension	Techniques
<i>Participation</i>	Providing education about dysarthria to patient, family and/or school, and advice on promoting self esteem, to increase social interaction and participation in society, facilitate interaction in the work place, and communication on social settings. This will lead to increased autonomy, which is associated with general well being and quality of life.

7. What is the management for dysarthria?

“Traditionally, speech and language therapists have managed dysarthria by assisting in differential diagnosis, treating the speech problem, and preventing secondary complications by facilitating participation in normal activities (Yorkston 1996, cited in Sellars C, Hughes T, et al, 2005) Dysarthria is most often a symptom of a disorder which affects the individual in many ways, and therefore the Speech and Language Therapist must have information about underlying condition, and will come into contact with many other disciplines (Yorkston, 2007) The work of the Speech and Language Therapist should reflect and be integrated into local and national guidelines for specific disorder, and will normally be part of an interdisciplinary team (RCSLT, 2006).

Care pathway for a child with stable dysarthria

The SLT will:

- assess and monitor progress
- maximise overall communication skills, including developing the use of effective communication and language systems.
- introduce sustainable strategies to assist integration into school
- provide education for the teachers and carers.
- promote access to the curriculum.
- work to minimise secondary difficulties of communication problems such as behavioural and emotional difficulties.
- support and educate the parents.
- work to provide communicatively responsive environments.

(RCSLT, 2006)

Care pathway for an adult with stable dysarthria

The SLT will:

- provide early assessment in the acute phase.
- provide goal orientated Speech and Language Therapy in the rehabilitation phase.
- provide well planned and flexible discharge to community living including communication goals.
- assist with long term rehabilitation in the community.
- provide intervention on a review-intervention-review basis.

(RCSLT, 2006)

Care pathway for an adult with progressive dysarthria:

For progressive conditions, staging of intervention is essential so current problems can be addressed and future ones anticipated, and the Speech and Language Therapist must be prepared

to move from one type of intervention to another, in order to maintain communication function (Yorkston, 2007). The SLT will do the following, as required:

- diagnostic assessment; which may include speech motor examination and perceptual assessments. Instrumental assessments: covering respiratory function, phonation, resonance, articulation, prosody and intelligibility. They will also assess communication skills, the patient's perceptions of the condition, psychosocial impact of the condition, and the role of conversational partners.
- formulate and negotiate short and long-term goals with the patient and their family.
- maintain continued episodes of intervention with monitoring of progress towards goals.
- reassess the patient at key junctures

(RCSLT, 2006)

Augmented and Alternative Communication

Augmentative and Alternative Communication (AAC) refers to any system of communication that is used to supplement or replace speech, to help people with oral communication impairments to communicate. For individuals with dysarthria this could range from 'low tech' aids such as drawing and writing, or communication books, to 'high tech' aids such as computerised voice output communication aids.

The objectives of introducing AAC to an adult with an acquired communication problem is to maximise their communicative function in the areas of life that are seen as a priority by the patient and family, and continually review the changing needs of the patient. It is necessary to:

- identify participation and communication needs
 - assess capabilities in order to determine appropriate options
 - assess external constraints
 - Find strategies for evaluating the success of interventions.
- (Beukelman & Mirenda, 1998)

To ensure appropriate access to the range of resources available, individuals who may benefit from communication aids should have access to an AAC specialist or team, who are skilled in assessment, planning, intervention and review in this area.

The Speech and Language Therapist will be working as part of multidisciplinary team, including people from health, social and voluntary organisations. They will also be including within the management process the individual's family members and others in their communication environment.

There are time implications for the education and training that SLTs provide to other professionals and family members. Working as part of a multidisciplinary team necessitates taking on team roles, and attending meetings, which also have time implications.

Cultural diversity

Individuals who use English as their second language and have dysarthria, along with their families, may need help to access services. An interpreter may be required to assist with conducting the SLT assessment to ensure it is both accurate and reliable and to facilitate understanding of therapy and implementation of treatment strategies. There are time and cost implications when working with interpreters/co-workers for example, in taking a case history, completing a full assessment in all languages spoken by the individual and their family. SLTs working with people with dysarthria need

to be aware of cultural and religious factors which may impact on ability to access services, e.g. timings of services need to be culturally sensitive, for example, not offering appointment times which coincide with religious observations (Communicating Quality 3, 2006).

8. What is the evidence for SLT interventions for dysarthria?

Details of studies

All of these studies consider speech and language interventions for patients with dysarthria. The studies are all published in English, with the earliest being published in 2001. Five of the studies were conducted in the UK, four in the USA, one in Canada and one in Australia. The other six studies were systematic reviews and synthesised results from studies conducted worldwide. The number of subjects investigated in the research studies ranged from 6 to 43. Subjects ranged in age from 4-85. The studies covered a range of speech/language therapy interventions and associated factors including the severity and type of dysarthria, aetiological condition associated with dysarthria, computer-based interventions and acceptability of treatment.

Study quality

Generally, the quality of the studies was good. The three Cochrane systematic reviews (Deane et al 2001a; Deane et al 2001b; Sellars, Hughes, & Langhorne 2005) were of excellent quality. Cochrane reviews are generally considered to be high quality examples of the systematic review methodology. Two other systematic reviews were also excellent and produced as part of a guideline development process (Yorkston, Hanson, & Beukelman 2004a; Yorkston, Spencer, & Duffy 2003). While the Cochrane reviews only included RCTs, the other reviews included any intervention study regardless of the study methodology. The other review (Palmer & Enderby, 2007) was good and focused, providing information about the different interventions that summarise or comment on the methodological quality of the included studies. There was one good quality randomised controlled trial (RCT) although it only investigated a small number of children (Sapir et al, 2007). The rest of the studies were clinical trials or case series studies. The results from these studies need to be interpreted with caution due to the limitations of clinical trials and case series research i.e. lack of randomisation introducing bias. Additionally, the majority of the studies only investigated a small number of patients limiting their generalisability.

It is worth noting that the findings from the non-UK papers need to be interpreted cautiously due to generalisability of findings to the UK population.

Considerations of Speech Language Therapy interventions

The studies examined a range of components of Speech and Language Therapy (SLT) interventions and their effect on outcomes.

Types of Speech Language Therapy Interventions

Speech and Language Therapy

Two Cochrane systematic reviews were conducted by Deane and Colleagues (Deane et al 2001a; Deane et al 2001b) on speech and language therapy for dysarthria in Parkinson's disease. One of the reviews (Deane et al, 2001a) compared the efficacy of speech and language therapy versus no

treatment in dysarthria in patients with Parkinson's disease. The review included 3 RCTs. The review concluded that due to the methodological flaws of all of the RCTs and the small numbers of patient that they investigated it was not possible to support one form of speech and language therapy for dysarthria in patients with Parkinson's disease. The other review (Deane et al. 2001b) focused on comparing the effects of different techniques. The review only included RCTs which limited the included studies to two. One study compared the effect of prosodic exercise alone and with visual feedback and the other study compared LSVT with respiratory therapy. The review concluded that there was insufficient evidence for any particular speech and language therapy technique for dysarthria in patients with Parkinson's disease.

Expiratory muscle strength training

One controlled clinical trial (Chiara, Martin, & Sapienza, 2007) considered the effect of expiratory muscle strength training (EMST) on voice production, dysarthria and voice-related quality of life issues in patients with multiple sclerosis. Study participants received 8 weeks of EMST followed by 4 weeks of no training. EMST increased maximal expiratory pressure but did not improve voice production or voice-related quality of life for patients with multiple sclerosis. The degree of dysarthria was not recorded meaning that the findings from this study may not be generalisable to all multiple sclerosis patients with dysarthria.

Modifying speech rate

One study focused on modifying the speech rate of children and young people with dysarthria. The research investigated the effect of a computer-based programme, Stepping Stones, on the subject's speech rate (Thomas-Stonell, Leeper, & Young, 2001). Subjects were aged 4-20 years and the study aimed to increase or decrease their speech rate as each individual's condition required. All patients managed to increase or decrease their speech rate and gains for all but one patient were maintained 4 weeks after treatment finished. The youngest patient, aged 4, was able to decrease their speaking rate while using Stepping Stones but not in general speech and by the review session 4 weeks after treatment ended had returned to pre-treatment levels indicating that the child might have been too young to fully benefit from the programme perhaps unable to fully understand the idea of modifying speech rate.

Lee Silverman Voice Treatment (LSVT)

Three of the systematic reviews and three intervention studies considered the effect of LSVT on Parkinson's Disease patients with dysarthria.

The two Cochrane reviews by Deane and Colleagues (Deane et al 2001a; Deane et al 2001b) each included an RCT that investigated the effect of LSVT. Both of the reviews conclude that there was insufficient evidence to make any recommendations about the effectiveness of the different treatments for dysarthria. The other systematic review (Yorkston, Spencer, & Duffy, 2003) found 16 intervention studies on LSVT in patients with Parkinson's disease. The review concluded that there was strong evidence for immediate post-therapy improvement and some evidence of long-term maintenance.

Two research studies considered the effect of LSVT on vocal loudness in patients with Parkinson's Disease (Ramig et al, 2001; Sapir et al, 2007). In the RCT (Sapir et al. 2007) subjects with Parkinson's were randomly assigned to either receive LSVT or no treatment and the results were compared with a control group who did not suffer from Parkinson's disease were also compared. In this small RCT LSVT increased the vocal loudness of subjects with Parkinson's disease. In the

controlled clinical trial (Ramig et al, 2001) patients who received LSVT were compared with patients with Parkinson's Disease who received no treatment and a control group who did not have Parkinson's Disease or any speech or voice abnormalities. Treated individuals increased their voice sound pressure levels. Changes were statistically significant and perceptibly audible. These two studies only investigated a small number of patients but the findings with other studies provide additional support to the efficacy of LSVT for the treatment of Parkinson's Disease.

Further evidence is provided by Wohlert (2004) who investigated the effect of different intensities of Lee Silverman Voice Therapy (LSVT) on patients with hypokinetic dysarthria as a result of Parkinson's disease. Patients either received treatment four times per week for four weeks or two times per week for 8 weeks or two times per week for four weeks. All participants, irrespective of the intensity of their treatment schedule, increased their voice intensity while reading aloud. All participants were requested to practice the same amount of time at home so the amount patients practiced in their own time could have affected the study outcomes. This study indicates that the LSVT might be useful for patients with hypokinetic dysarthria as a result of Parkinson's Disease.

The findings from these studies indicate that LSVT could be effective in treating patients with dysarthria as a result of Parkinson's disease.

Behavioural Communication Intervention

One systematic review (Yorkston, Spencer, & Duffy, 2003) considered different behavioural techniques for management of respiratory/phonatory dysfunction in patients with dysarthria. The review included 35 studies separated into four broad categories: biofeedback, device utilisation, LSVT and several miscellaneous studies. Biofeedback is most relevant for this section of the synthesis. Evidence from the review suggests that biofeedback can be effective in changing physiological variables.

A pilot study (MacKenzie & Lowit, 2007) considered the effectiveness of a behavioural communication intervention on patients with dysarthria following stroke, which included strategies to increase volume, reduce speed of speech and improve intelligibility. Each of the eight patients received an individually tailored programme over an 8 week period which consisted of 16 sessions. The study found that some of the subjects benefited from the intervention and maintained their improvement at 2 month follow-up. The results from this small study indicate that such an approach could be useful with some patients following a stroke.

(Robertson, 2001) considered the effectiveness of oro-facial and articulation exercises for patients with dysarthria following stroke. A group of speech and language therapists agreed a clinic-based therapy programme and an exercise routine for home practice for each of the patients. Of the eight subjects that completed the full trial six of the eight subjects increased their overall dysarthria scores. One subject scored lower and two were within 1 point of their original score. Subjects that completed more practice at home made the greatest improvement overall.

Speech supplementation strategies

Two studies considered the effectiveness of speech supplementation strategies. One study was a systematic review which was produced as part of a guideline development process and one was a case series.

The systematic review (Yorkston, Hanson, & Beukelman, 2004b) considers four general types of speech supplementation: alphabet supplementation, semantic or topic supplementation, gestures

and syntactic supplementation. Included studies considered patients with any severity of dysarthria associated with any aetiological conditions. All patients' words and sentences intelligibility increased, regardless of the supplementation strategy used. The review concluded that speakers with severe or profound dysarthria, regardless of medical diagnosis or type of dysarthria, might find supplementation strategies useful. The case series study (Hustad, Dailey, & Jones, 2003) compared the effectiveness of 3 speech supplementation strategies on subjects intelligibility and speech rate. The three strategies were: topic, (where the listener is provided with information on the topic area prior to the communication) alphabet (where the speaker points to the first letter of each word as it is spoken) and combined, topic and alphabet supplementation. Combined supplementation and alphabet supplementation produced significantly higher intelligibility scores and slower speech rate than the topic and also the control group who received no supplementation. This study only investigated a small number of subjects which limits the generalisability of these findings.

Systems approach

One case series (Pennington, Smallman, & Farrier, 2006) considers therapy focusing on speech production for six students with cerebral palsy. The students received intensive individual therapy five days per week for five weeks from two speech and language therapy students. All CP students were unable to attend all of the 25 therapy sessions for various reasons. The CP students' average single word intelligibility increased but not their continuous speech intelligibility. However, when intelligibility was tested again 7 weeks after the end of the treatment all but one student had returned to pre-treatment levels. The students felt that the therapy that had received had been useful. A number of students thought less frequent therapy would have been preferable. This systems approach to therapy could be beneficial to children with cerebral palsy in helping some to increase the intelligibility of their speech and appears to have been acceptable to the students in this study. Further research investigating the use of systems approach and also different intensities of therapy would be beneficial.

Intensity of intervention

It is generally believed that high intensity intervention is best. High intensity is part of the basis for LSVT treatment which is one of the only proven effective treatments. Two studies (Pennington, Smallman, & Farrier 2006; Wohlert 2004) found that the intensity of the speech and language therapy intervention is an important factor to consider. The studies found that some of the patients preferred lower intensities of treatment. One investigated the effect of different intensities of the Lee Silverman Voice Treatment (Wohlert, 2004). All participants, irrespective of the intensity of their treatment schedule, increased their voice intensity while reading aloud indicating that the intensity of treatment might not affect the outcome. The study attempted to randomly assign participants to treatment schedules but four patients requested and were assigned to the eight treatment sessions (2 X 4 conditions) due to transportation issues indicating that this lower intensity might be more acceptable to some patients. A case series (Pennington, Smallman, & Farrier, 2006) considers therapy focusing on speech production for six students with cerebral palsy. Each of the six students received intensive individual therapy five days per week for five weeks from two speech and language therapy students. All students were unable to attend all of the 25 therapy sessions for various reasons. A number of students thought less frequent therapy would be preferable. Further research investigating different intensities of therapy would be beneficial as less frequent treatment would be cheaper to provide and possibly easier for patients in terms of travel and costs and may have similar impact.

Timing of intervention

There is evidence that certain individuals with dysarthria can benefit from speech and language therapy a long time after its onset improving not only the quality of speech but also intelligibility (Enderby & Crowe 1990, Palmer, Enderby & Cunningham, 2004, Palmer, Enderby & Hawley, 2007).

Type of Dysarthria

Chronic dysarthria

A case series study (Palmer, Enderby, & Cunningham, 2004) considered the effect of three different speech and language therapy practices on the articulation of single words in patients with chronic dysarthria. Their results were compared with individuals without dysarthria. The three practices were reading of written target words, visual feedback and an auditory model followed by visual feedback. All of the eight participants in the study altered their speech production. For speakers with chronic dysarthria copying an auditory target gave significantly better recognition scores than only repeating the word. Visual feedback was no more effective than repetition alone.

Stable dysarthria

A systematic review and a case series investigated the speech and language therapy for patients with stable dysarthria.

The systematic review (Palmer & Enderby, 2007) reviewed the effect of different speech therapy treatments. The review included any studies where participants had long-standing non-progressive dysarthria as a result of traumatic brain injury, following stroke or with cerebral palsy. 23 papers were included in the review. The review was unable to draw conclusions about the efficacy of the different treatments for stable dysarthria as the research studies use small numbers of subjects and the treatment techniques investigated were different and thus the authors summarised the different treatment techniques. Categories of treatments investigated were rate, resonance, oromotor, articulation, prosody, compensatory strategies, treatment programmes and treatment of longstanding dysarthria.

The case series study (Palmer, Enderby, & Hawley, 2007) compared computerised and traditional therapy for speakers with longstanding stable dysarthria. The computer programme allowed individuals to practice with feedback. Both treatments improved the speech of the subjects. The computerised treatment was found to be as effective as the traditional therapy. This pilot study demonstrates that computerised therapy could be useful for improving the speech of patients with stable dysarthria and assists in providing intensive interaction.

Aetiological condition associated with Dysarthria

Parkinson's Disease

Patients with dysarthria as a result of Parkinson's disease were investigated in five of the studies. Some of the studies only investigated patients with Parkinson's disease and some investigated them with patients with other aetiological conditions.

Two Cochrane systematic reviews were conducted by Deane and colleagues (Deane et al 2001a; Deane et al 2001b) on speech and language therapy for dysarthria in Parkinson's disease. One (Deane et al. 2001b) focused on comparing the effects of different speech and language therapy techniques. The review only included RCTs limiting the included studies to two. The review concluded that there was insufficient evidence for any particular speech and language therapy

technique for dysarthria in patients with Parkinson's disease. The other Cochrane review, also by Deane and colleagues (Deane et al, 2001a), compared the efficacy of speech and language therapy versus no treatment in dysarthria in patients with Parkinson's disease. The review concluded that due to the methodological flaws of all of the RCTs and the small numbers of patient that they investigated it was not possible to support one form of speech and language therapy for dysarthria in patients with Parkinson's disease.

Three research studies (Ramig et al. 2001; Sapir et al. 2007; Wohlert 2004) considered the effect of LSVT on patients with dysarthria as a result of Parkinson's Disease. One RCT study evaluates the effectiveness of LSVT on vocal loudness in patients with idiopathic Parkinson's disease (Sapir et al, 2007). In this small RCT LSVT increased the vocal loudness of subjects with Parkinson's disease. The controlled clinical trial also found that the patients who received LSVT increased their vocal loudness. The case series (Wohlert, 2004) investigated the effect of different intensities of LSVT on patients. All participants, irrespective of the intensity of their treatment schedule, increased their voice intensity while reading aloud. These studies indicate that LSVT could be an effective treatment for patients with Parkinson's Disease.

Cerebral Palsy

Two of the included studies investigated the treatment of patients with cerebral palsy. Both studies were case series, one investigated the impact of therapy focusing on speech production and the other 3 different speech supplementation strategies.

One case series (Pennington, Smallman, & Farrier, 2006) investigated the effect of therapy focusing on speech production for six students with cerebral palsy. The students' average single word intelligibility increased after the therapy but their continuous speech intelligibility did not. However, when intelligibility was tested again 7 weeks after the end of the treatment all but one student had returned to pre-treatment levels. There is insufficient evidence about the effect of the systems approach to therapy on children with cerebral palsy. Further research investigating the use of systems approach would be useful

The other case series (Hustad, Dailey, & Jones, 2003) compared the effectiveness of 3 speech supplementation strategies on subjects intelligibility and speech rate. The three strategies were: topic, alphabet and combined topic and alphabet supplementation. Combined supplementation and alphabet supplementation produced significantly higher intelligibility scores and slower speech rate than the topic and also control group who received no supplementation. This study only investigated five subjects, four of which had cerebral palsy which limits the generalisability of these findings.

Multiple Sclerosis

One study (Chiara, Martin, & Sapienza, 2007) considered the treatment of patients with dysarthria associated with multiple sclerosis. The effect of expiratory muscle strength training (EMST) on voice production, dysarthria and voice-related quality of life issues was investigated in 17 persons with multiple sclerosis who were compared with 14 healthy volunteers. Study participants received 8 weeks of EMST followed by 4 weeks of no training. This study found that EMST increased maximal expiratory pressure but did not improve voice production or voice-related quality of life for patients with multiple sclerosis. The patients in this study had mild to moderate level of disability. The degree of dysarthria was not used as a selection criteria and it was not reported meaning that the results may not be generalisable to all multiple sclerosis patients with dysarthria.

Motor Neurone Disease

None of the studies, selected here, investigated patients with motor neurone disease alone. One study (Hird & Hennessey, 2007) investigated the use of speech recognition software in patients with dysarthria associated with a variety of aetiological conditions including motor neuron disease. The effects of physiological, behavioural and pragmatic treatment approaches on patients' use of the PowerSecretary software were studied. The study showed that all patients were able to use the software irrespective of their medical diagnosis or type of dysarthria. The study measured dictation rates and found that they tended to be higher in patients that received the physiological or pragmatic treatment compared with patients that received the behavioural treatment. As the results for patients with motor neurone disease were not analysed separately it is not possible to make recommendations of this treatment for these patients although patients with motor neurone disease were able to use the software.

Non-progressive brain damage

A Cochrane Systematic Review (Sellars, Hughes, & Langhorne, 2005) investigated speech and language therapy for adults with dysarthria caused by non-progressive brain damage. The review found no unconfounded RCTs in this area meaning that the review concluded that no evidence was found to support or refute the effectiveness of different speech and language therapy.

Stroke

Two small research studies investigated different treatments for patients with dysarthria following stroke.

A pilot study (MacKenzie & Lowit, 2007) considered the effectiveness of a behavioural communication intervention on patients with dysarthria following stroke. Each of the eight patients received an individually tailored programme over an 8 week period which consisted of 16 sessions. The study found that some of the subjects benefited from the intervention and maintained their improvement at 2 month follow-up. The results from this small study indicate that such an approach could be useful with some patients following a stroke.

One case series study (Robertson, 2001) considered the effectiveness of oro-facial and articulation exercises for patients with dysarthria following stroke. A group of speech and language therapists agreed a clinic-based therapy programme and an exercise routine for home practice for each of the patients. Of the eight subjects that completed the full trial six of the eight subjects increased their overall dysarthria scores. One subject scored lower and two were within 1 point of their original score. Subjects that completed more at home practice made the greatest improvement overall.

Computer-based interventions

Three of the research studies investigated the effect of computer-based interventions on the speech of patients with dysarthria. Together the studies indicate that computer-based interventions could be effective for patients with dysarthria.

One research study (Thomas-Stonell, Leeper, & Young, 2001) investigated the effect of a computer-based programme, Stepping Stones, on the speech rate of children with dysarthria. Subjects were aged 4-20 years and the study aimed to increase or decrease their speech rate as each individual's condition required. Use of the programme enabled all patients to increase or decrease their speech rate and gains were generally maintained 4 weeks after treatment finished. The findings from this

study suggest that the programme, Stepping Stones, can be successfully used by patients with dysarthria due to a variety of conditions and that it can be effective in patients aged from 8-20 years. One case series study (Palmer, Enderby, & Hawley, 2007) compared computerised and traditional therapy for speakers with longstanding stable dysarthria. The computer programme allowed individual practice with feedback. The computerised treatment was found to be as effective as the traditional therapy. This pilot study demonstrates that computerised therapy could be useful for improving the speech of patients with stable dysarthria without needing extensive time and input from speech and language therapists.

The use of speech recognition software in patients with dysarthria associated with a variety of aetiological conditions was investigated in a comparison study (Hird & Hennessey, 2007). The study investigates the effects of physiological, behavioural and pragmatic treatment approaches on patient's use of the PowerSecretary software. All patients were able to use the software irrespective of their medical diagnosis or type of dysarthria. Patients with more severe dysarthria took longer to complete the initial training in using the software but were able to successfully use it to some degree. The study measured dictation rates and found that they tended to be higher in patients that received the physiological or pragmatic treatment compared with patients that received the behavioural treatment. Although the results of this small study should be interpreted with caution the possible finding that patients with any severity of dysarthria could successfully use computer software is worth further investigation.

Acceptability of treatment

Two of the studies considered the acceptability of the treatment for patients. (Wohlert, 2004) investigated the effect of three different intensities of LSVT on patients with hypokinetic dysarthria. The study attempted to randomly assign participants to treatment schedules four patients requested and were assigned to the eight treatment sessions (2 X 4 conditions). This indicates that lower intensities of treatment might be more acceptable to patients. This preference for lower intensities of therapy was also found in the other case series by (Pennington, Smallman, & Farrier, 2006) which considers therapy focusing on speech production for six students with cerebral palsy. Each of the six students received intensive individual therapy five days per week for five weeks from two speech and language therapy students. All students were unable to attend all of the 25 therapy sessions for various reasons. The students felt that the therapy that had received had been useful. A number of students thought less frequent therapy would be preferable.

Summary

Dysarthria occurs at different levels of severity in a number of different aetiological causes. The most appropriate and successful treatment for dysarthria is heavily determined by the patients underlying condition and personal circumstances making it difficult to generalise about what will be effective for different patients. However treatment seems to be acceptable to patients, and there is some evidence that different approaches are effective in treating Dysarthria associated with different underlying causes.

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Dysarthria synthesis

Study	Country	Study design	Subjects	Intervention
(Chiara, Martin, & Sapienza 2007)	USA	Controlled Clinical Trial	31 subjects. 17 adults with multiple sclerosis, 3 males, and 14 females, aged 48.9±7.61. Their results were compared with 14 healthy controls aged 44.1±7.64.	Expiratory muscle strength training over 8 weeks. Patients ideally trained 5 days per week, 1 session with investigator and other 4 days on own.
(Deane et al. 2001a)	International	Systematic Review	Patients with diagnosis of Parkinson's disease, any age. 63 patients in 3 included trials but only numerical data for 41 patients.	One trial investigated individual therapy with an emphasis placed on prosodic features of pitch and volume reinforced with the use of a number of visual feedback systems. One investigated mainly group therapy aimed at increasing loudness

Study	Country	Study design	Subjects	Intervention
				and pitch variation. One investigated LSVT aimed solely at maximising phonatory effort and increasing volume carried out on an individual basis.
(Deane et al. 2001b)	International	Systematic Review	Patients with dysarthria in Parkinson's disease. 71 patients in 2 trials.	One trial compared prosodic exercises with visual cues with prosodic exercises alone, other compared Lee Silverman Voice Therapy (LSVT) with respiratory therapy.
(Hird & Hennessey 2007)	Australia	Comparison study	15 adults with dysarthria associated with a variety of aetiological conditions. 12 men, 4 women, aged 18-81, average age 53 years.	Facilitating use of speech recognition software with physiological, behavioural and pragmatic treatment.
(Hustad, Dailey, & Jones 2003)	USA	Case series	5 adults with chronic severe dysarthria aged 33-58 years.	Speech supplementation strategies – topic, alphabet and combined topic and alphabet.
(MacKenzie & Lowit 2007)	UK	Pilot study	8 adults with dysarthria following stroke. Time from initial stroke ranged from 3 to 80 months and age from 47 to 75 years.	Behavioural communication treatment tailored to the individual. Sessions lasted 45 minutes and were twice weekly for 8 weeks i.e. 16 sessions. Patients were also encouraged to undertake daily practice for 15 minutes.
(Palmer, Enderby, & Cunningham 2004)	UK	Case series	8 subjects across a continuum of severe, moderate and mild dysarthria. 4 males & 4 females, aged 24-44 years.	Study compared 3 practice conditions. 1. Participant received auditory and kinaesthetic feedback on pronunciation but no computer-generated feedback. 2. Participant received immediate computer-generated visual feedback. 3. Participants listened to words first, tried to

Study	Country	Study design	Subjects	Intervention
				imitate them and received immediate computer-generated visual feedback on their attempts. Each participant was visited at home for 45-60 minutes weekly for 4 weeks.
(Palmer, Enderby, & Hawley 2007)	UK	Case series	7 clients with long-standing stable dysarthria	Compares 6 week blocks of weekly traditional treatment with 6 weeks blocks of computer based treatment over 6 month period. Computerised therapy allows individual to practice with feedback. Traditional therapy carried out by qualified Speech and Language Therapist.
(Palmer & Enderby 2007)	International	Systematic review	Patients with long-standing non-progressive dysarthria. Stable dysarthria experienced by people with TBI, cerebral palsy or following stroke.	Different speech therapy treatments. Treatment
(Pennington, Smallman, & Farrier 2006)	UK	Case series	6 children aged 10-18 years with cerebral palsy. 4 females, 2 males, mean age 15 years	Intensive individual therapy focusing on speech production delivered by 2 Speech & Language Therapy Students. Sessions were 20-30 minutes long 5 day a week for 5 weeks.
(Ramig et al. 2001)	USA	Controlled clinical trial	43 patients – 21 males and 22 females. 29 had Idiopathic Parkinson's Disease (IPD) and 14 were neurologically normal individuals without voice and speech abnormalities.	14 patients with Parkinson's Disease received four one hour sessions per week of Lee Silverman Voice Treatment (LSVT) for 4 weeks. 15 Parkinson's Disease patients received no treatment. 14 subjects without Parkinson's Disease acted as a control

Study	Country	Study design	Subjects	Intervention
				group.
(Robertson 2001)	UK	Case series	8 subjects with dysarthria following stroke. 6 males average age 72.5, range 69-80 years. 2 females average age 68, range 67-69 years.	Oro-facial and articulation exercises. 10 week block of 45 minute weekly training sessions with home practice.
(Sapir et al. 2007)	USA	RCT (small)	42 subjects- 14 adults with Parkinson's received treatment, 15 with Parkinson's received no treatment and 14 age matched healthy individuals.	LSVT , 4 60 minute sessions of individual therapy per week for 4 weeks.
(Sellars, Hughes, & Langhorne 2005)	International	Systematic Review	Review searched for literature on speech and language therapy for adults with dysarthria due to non-progressive brain damage. No trials were found.	Intervention searched for were any delivered, directed, determined or facilitated by an SLT.
(Thomas-Stonell, Leeper, & Young 2001)	Canada	Case Series	12 subjects – 5 females, 7 males, age range 4-20 years. Children had dysarthria as part of a physical or neurological disability.	Computer-based programme for training speech rate. 3-phase repeated measure design. Baseline phase of 10 sessions (30 to 45 minutes long) Training phase of 10 rate modification sessions. Recheck phase was 4 weeks following the end of training.
(Wohlert 2004)	Mexico, USA	Case Series	11 individuals with hypokinetic dysarthria as a consequence of Parkinson's disease. 9 male, 2 female, aged 53-85.	Patients were assigned to receive Lee Silverman Voice Treatment on one of 3 treatment schedules. 4 times per week for 4 weeks, 2 times per week for 8 weeks or 2 times per week for 4 weeks.
(Yorkston, Spencer, & Duffy 2003)	International	Systematic Review	Review included 35 intervention studies.	Behavioural techniques for the management of respiratory/phonatory dysfunction in dysarthria –

Study	Country	Study design	Subjects	Intervention
				biofeedback, device utilisation, LSVT and miscellaneous studies.
(Yorkston, Hanson, & Beukelman 2004a)	International	Systematic Review	Review included 19 trials with a cumulative total of 89 subjects aged 9-87 years.	Speech supplementation techniques – alphabet cues, semantic cues, gestures and combined.

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