12 Treatment of Dysarthria with FES

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12.1 Introduction

Dysarthria is the term used to describe acquired speech disorders following neurological disease. It is caused by a disorder of the speech motor system. Dysarthria is the most common acquired communication disorder. The incidence exceeds aphasia by about twice [1]. Dysarthria affects communication in everyday life (partnership and family) and in the outside world (work and contacts) [2]. Despite this relevance, there is relatively little research on this disorder. The German Society of Neurology [3] recommends in its guidelines only one exercise-based procedure, namely LSVT® (Lee Silverman Voice Treatment) [4], which was essentially developed for Parkinson's disease and is mainly designed to increase speech volume. However, most dysarthria results from non-progressive diseases of the brain (hemorrhage, insult, trauma), in which the focus of disturbance is articulation. The aim of this paper is to fill this gap and to show a viable alternative course of action. We describe the diagnosis and therapy of dysarthric movement disorders mainly of the lips, tongue, and mandible. We ask to see this as a very promising tool, which of course must be inserted into a treatment concept that also integrates other levels of the disorder, e.g., participation, according to the ICF. A complete concept can be found in Kroker et al. [5]. In this article, mainly the treatment on the level of body structure is described (treatment of lips, tongue, and jaw motor function). In a small group study [5] it was shown that no further transfer exercises are needed to improve body function (speech). Transfers to activity and participation, i.e., whether a patient benefits in everyday life were studied only to a limited extent. Additional research would be needed in this area.

12.2 General Preliminary Considerations for Stimulation in the Cervical Region

In general, electrotherapeutic treatment in the anterior neck region is viewed critically. However, this attitude is based only on individual expert opinions [6]. Theoretically, there are two sources of danger here: Electrical irritation of the vocal folds could lead to laryngospasm and thus respiratory distress. A second aspect is stimulation of the carotid sinus. This represents the beginning of the internal carotid artery behind the carotid

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bifurcation. It is thus located approximately at the level of the thyroid—somewhat laterally, although the height can vary greatly from patient to patient. The vessel wall of this arterial segment contains baroreceptors, which are thought to cap blood pressure spikes in healthy individuals. When these receptors are stimulated, there is an increase in vagotone resulting in a decrease in heart rate (bradycardia) and blood pressure. Pathologically increased stimulation of these receptors is called carotid sinus syndrome. Here, even a slight pressure in the neck area, such as that produced by a tight shirt collar, can cause a patient to collapse. The therapy here is a pacemaker [7], which then intrinsically limits the use of other electrical stimulation. In practice, however, these two complications associated with electrical stimulation do not usually occur. Initial trials of electrical stimulation for dysphagia were conducted under intensive care conditions [8], but without corresponding complications.

Crary et al. [9] surveyed 5000 therapists who used cervical electrical stimulation for dysphagia. No serious complications occurred. This problem also did not occur with the use of medium frequency currents, which penetrate deeper into the tissue, at least in a small pilot study with stroke patients [10]. However, there have been some successful attempts to use carotid nerve stimulation therapeutically, e.g., in angina pectoris or essential hypertension. However, this was done with implanted electrodes [11]. Interestingly, similar stimulation parameters were used as are common in dysphagia treatment (20–80 Hz/0.35 ms). In the field of voice therapy, most authors do not refer to this problem at all, e.g. [12, 13], although here the electrodes are applied exclusively to the neck. It should be noted, however, that electrotherapy devices used in the anterior neck region must now be approved in most countries specifically for this area of application. The foregoing considerations are relevant to the treatment of dysarthria only when the voice is to be additionally treated; in articulation treatment, stimulation is not applied in the anterior neck region. However, the arguments should also be considered for dysphagia and laryngeal paresis.

▶ – Articulation disorders in dysarthria can be treated with common approved stimulators.
– For FES in the anterior cervical region in voice and swallowing disorders, use devices that are approved for this application in most countries.

12.3 Symptomatology of Individual Forms of Dysarthria

Speech is an extraordinary fine-motor complex and fast process. Hardly any other organ of the human body performs such virtuoso movements [14]. Therefore, it is not sufficient to assess the articulators (tongue, lips, mandible, soft palate) only in their gross motor movements and muscle tone, but also to consider the complex interaction and neuromuscular prerequisites of these muscle groups.

The authors use articulation speed as the central test instrument for measuring articulatory skills in dysarthria [5]. Here, an attempt is made to reproduce the underlying movement disorder using defined consonant clusters and to draw conclusions about or classify certain phenotypes. To describe the speech exercises, we use the international phonetic alphabet. This is achieved by repeating syllables (/ʃla/, /bla/, /kla) representing different movement patterns under time pressure in a metronome beat.

The authors follow the commonly used classification [5, 14] for dysarthria according to the type of movement disorder:

– Spastic dysarthria results from damage to the upper motor neuron. On examination of non-speech tongue and lip movements, usually only mild facial paresis is detectable, but from our experience, this tends to have no real disease value with respect to articulation, as the lips produce complete closure when speaking bilabial sounds. The tongue, on the other hand, shows a gross motor normal mobility, mostly without deviation from the midline, because in case of unilateral brain damage the vagus nerve and hypoglossal nerve are supplied bilaterally, and central paralysis can be compensated to a certain degree [15]. The main pathology usually manifests itself in the fact that the tip of the tongue can no longer be raised quickly enough during speech. Thus, in our articulation test, the sound /l/ is omitted in the test syllable /ʃla/ if it is produced under time pressure. The voice may also be affected, but the dysphonia usually plays only a minor role.

– Flaccid dysarthria results from damage to the lower motor neuron, i.e., in the brain stem. Significant severe paresis of all articulators is quite possible and not uncommon. Often all test syllables (/ʃla/, /bla/, /kla/) are affected. Characteristic is the fatigue if a syllable is repeated over a longer period (>10s). This leads to weakness and thus to a deterioration of the articulation. This is called a myasthenic reaction [5]. Such a fatigue reaction is also a typical symptom of flaccid paresis in body motor function. Deviation of the tongue from the midline is quite possible; unilateral paresis of the genioglossus muscle causes the tongue to deviate toward the affected side. Articulatory significant restrictions in the mobility of the jaw, the lips, and the velum occur. The voice is often hissed to aphonic, and laryngoscopy may frequently reveal vocal fold paresis.
– Ataxic dysarthria usually results from damage to the cerebellum. Gross motor articulators usually show no deficits. The test syllables (/ʃla/, /bla/, /kla/) are not formed in a simplified way under time pressure. However, after a certain speed, the patient is no longer able to increase the tempo further and remains behind the given beat. One symptom of ataxic disturbed body motor function is intention tremor: this does not occur at rest, only during movement, and increases as the target is approached. In some patients, an intention tremor of the tongue can be observed during production of test syllables. The voice is often very loud and highly clenched, possibly due to a compensatory mechanism [14].
– Hypokinetic dysarthria occurs mostly in Parkinson's disease (PD). Since articulation is not the main symptom in most cases, but voice dysfunction is, this manifestation is not relevant for the present article. The gold standard here is LSVT® (Lee Silverman Voice Treatment), whose efficacy is now so well established by studies [4] that the authors do not wish to make any recommendations to the contrary here. Parkinson's patients often show fatigue when measured for articulation speed in the sense that they do not simplify the syllables but fall more and more behind the temporal target with increasing repetitions. This fatigue also occurs not infrequently in body motor skills, this is well observed in the writing pattern: This becomes progressively smaller over a line to the point of micrographia.
– Hyperkinetic dysarthria are rather rare in practice. They mostly occur in Huntington's disease or medication side effects. They manifest as exaggerated movements (dyskinesia) of the articulatory organs and voice. Due to the extreme rarity and the questionable treatability, the authors would like to exclude this form of dysarthria from our explanations as well.

12.4 Diagnostics of the Articulation Disorder

In this chapter, the authors would like to introduce the "Dys-SAAR-thrietherapie". The name is derived from "Saarland," the part of Germany where this form of therapy was developed.

The aim of diagnostics is to determine the type and extent of motor deficits on the part of the articulators. However, this does not allow a direct conclusion on the impairment of the ability to communicate, since articulation also depends on other contextual factors. For example, a slightly impaired articulatory motor function can be compensated by slow speech. In part, different dialects also specify different speech rates. Likewise, the phonation can be different. Thus, a (dental-aveolar) tongue-tip R (/r/) has a higher susceptibility to interference than a (uvular) tongue-back R (/R/). Similarly, different languages place different demands on articulatory motor skills due to different consonant clusters.

In sum, articulation speed does not necessarily represent speech clarity, but improving articulation speed will likely have the opposite effect on clarity. This was shown quite impressively in a pilot study with eight chronically dysarthric patients [5].

In the diagnostic procedure [5], the patient is given a metronome beat and instructed to repeat test syllables in this beat. The test syllables represent articulation movements that are important for speech:

- /bla/: Change from bilabial to alveolar phonation.
- /kla/: Change from velar to alveolar phonation.
- /ʃla/: Change within the alveolar zone.
- /amp/: Velum function.
- Each syllable is tested individually.

  If the patient can form the corresponding syllable at the given rate, the rate is increased. If motor errors occur, it is lowered. The articulation speed is the frequency in beats per minute (bpm) at which the syllable is just correctly formed. The normal velocity was over 208 bpm for the /ʃla/, /bla/, /kla/ clusters in a study of 10 patients with dysarthria. The normal articulation speed of the velar /amp/ was 180 [5]. In our experience, intermediate severities reach an articulation speed of 100 bpm. For this reason, it makes sense to start the measurement here. Severe disorders are below 50 bpm. Below this level, it becomes difficult for many patients to maintain such a slow beat. The speed of increasing the beat rate is up to the experience of the therapist. It is not a validated measurement. In addition to this quantitative value, the quality of the articulatory error must also be assessed. For this purpose, the affected articulator and the type of motor error are named:
- It should be noted that insufficient velum elevation has an influence on all clusters. If there is still a residual motor function, however, it can be assumed that there is a dependency on the frequency specification only for the syllable /amp/.

It is possible that in the case of very mild dysarthria, normal values are determined for the tested clusters. In this case, disturbed clusters must be taken from the spontaneous speech and threshold values must also be determined for them. Often it already represents an increase of the degree of difficulty, if the /a/ in the syllables is replaced by another vowel (e.g., /i/). This is because the formation of the /a/ requires contraction of the hyoglossus muscle and the /i/ requires activity of the genioglossus muscle, which seems to be more susceptible to interference. The most common simplifications result from elision of the /l/, which can be explained primarily by paresis of the intrinsic tongue muscles. Tip elevation and depression of the tongue is achieved primarily by the superior longitudinalis and inferior longitudinalis muscles, respectively (Table 12.1).

The elevation of the dorsum of the tongue (/k/) is mainly achieved by the extrinsic tongue muscles (styloglossus muscle, palatoglossus muscle).

The most complex sound is the /ʃ/, which is achieved by a complex interaction of intrinsic and extrinsic tongue muscles. Involved are: M. genioglossus, M. styloglossus, and M. longitudinalis inferior.

All intrinsic and extrinsic tongue muscles except the palatoglossus muscle are innervated by the hypoglossal nerve. Thus, electrical stimulation is performed at the floor of the mouth when hypoglossal motor function is impaired.

The most speech-relevant lip closure muscle is the orbicularis oris muscle. In the case of damage, this is not stimulated directly so as not to restrict the ability to move. The facialis main trunk is suitable here.

Jaw closure during articulation is essentially achieved by the pterygoid medius muscle but also by the masseter and temporal muscles. All are motorically innervated by the trigeminal nerve, on which stimulation is applied when indicated.

In addition, it is listed what kind of movement disorder can be identified:

– Spastic (simplification of the cluster without fatigue).The Video 12.1 shows a patient with spastic dysarthria speaking the cluster /ʃli/ at

Table 12.1 Disturbed clusters and possible errors

disturbed cluster	possible error	possible error
/bla/	/b/ - incomplete lip closure	/l/ - incomplete tongue tip elevation - lateralization
/kla/	/k/ - incomplete tongue dorsum elevation	/l/ - incomplete tongue tip elevation - lateralization
/ʃla/	/ʃ/ - sagittal grooving is flattened - lateralization - insufficient jaw closure	/l/ - incomplete tongue tip elevation - lateralization
/amp/	/m/ - velopharyngeal closure - incomplete lip closure	/p/ - incomplete lip closure - incomplete velopharyngeal closure

175 bpm correctly. At 179 bpm he simplifies the syllable to /ʃa/.

– Flaccid (simplification of the cluster with fatigue). The Video 12.2 shows a patient with flaccid dysarthria speaking the cluster /bla/ at 120 bpm. After a few seconds he simplifies the syllable to /ba/.
– Ataxic (deceleration without simplification and fatigue). The Video 12.3 shows a patient with ataxic dysarthria speaking the cluster /bla/ at 120 bpm correctly. At 125 bpm he can't follow the beat.

Movement disorder.

Additional videos with assessment examples of these disorders can be viewed at www.dysaarthrie.com. This form of diagnosis is the motor part of the Informal Dys-SAAR-thriediagnostik (DSD) [5]. The full implementation also includes a subtest that tests intelligibility on the telephone. However, for the everyday implementation of this therapy, this subtest is not necessary and can also be replaced by recordings of spontaneous speech at the beginning of therapy and as a follow-up, which is also a more comprehensible result for the patient. For scientific data collection, however, an intelligibility test can be useful. There are, of course, other alternatives, e.g., the German "Münchner Verständlichkeitsprofil (MVP)" [16].

▶

– The first step in diagnostics is to determine how quickly the syllables /ʃla/, /bla/, /kla/ can be formed in the metronome beat. In addition, it should be documented which movement sequences are realized incorrectly and how.
– In a second step, the speech ability should be documented (e.g., by speech recording).

12.5 Therapy of the Articulation Disorder

An unconditional prerequisite for Dys-SAAR-thrietherapie (DST) [5] is the motor diagnosis described above. The aim of the therapy is to train the affected movement disorder under defined and influenceable conditions exactly at the limit of success.

For this purpose, the following assumptions are made:

1. Most dysarthric patients can perform almost all required articulation movements but slowed down. If they nevertheless adopt the usual speech tempo, this results in a fuzzy articulation, which, on closer analysis, consists of a simplification of the movement

sequences. Thus, there are two options for therapy: slowing down the speech tempo or helping the articulatory motor system to regain faster movement sequences. The authors would like to discuss the second option here. For the first option some approaches also exist [17, 18].

2. Dysarthria always consists of a sensory and motor component. Many affected persons lack direct feedback since they are in principle able to articulate clearly. Exceptions are only the most severe motor impairments. The normal speaker can easily compensate for certain impediments to articulation. This phenomenon is called the "pipe smoker effect". This is because a pipe smoker is perfectly capable of articulating clearly despite the obstruction located in the mouth [14]. The same applies to patients with peripheral hypoglossal palsy [5], who can compensate articulatory for the loss of unilateral tongue motor function via compensatory mechanisms. The therapeutic consequence of this is that a dysarthric patient usually cannot give himself correct feedback, and thus cannot optimally decide whether he is training at the correct difficulty level. Thus, the therapist is always responsible for the feedback as a crucial influencing factor.
3. The difficulty level is calibrated via the feedback. This is a form of shaping, which is crucial for successful neurological rehabilitation [19]. A time signature with metronome allows for over 100 bpm (if one starts at about 100 bpm for a moderately severe disorder with a goal of 208) different difficulty levels per trained consonant cluster. Absolute individual fine-tuning to the patient is thus possible. A forced-use effect is achieved through the feedback and the associated fixation of attention on the disordered movement [5].
4. The authors assume that electrical stimulation in the mouth and throat area can have a very positive influence on motor learning. At least in dysphagia, this has been quite well studied [20].

A high therapy frequency is an obligatory prerequisite for a successful neurorehabilitation—this is true for the linguistic [21] as well as for the motor area [22]. Therapy with this approach should take place at least 3 weeks and optimally 5 weeks [5].

12.6 Practical Implementation

Choice of current parameters:

From the diagnostics, the first step is to determine the type of movement disorder. If it is a flaccid dysarthria, which has already existed for more than 4 weeks, it can be assumed with relative certainty that a muscle atrophy is present and that the affected musculature is probably no longer faradically excitable. Because faradic current cannot trigger a contraction in an atrophied muscle, much wider pulses are needed for this purpose. When selecting the current, it must be remembered here that the speech musculature works together in a complex manner. It can therefore be assumed, particularly in the case of hypoglossus-innervated muscles, that different muscles have different excitability thresholds. It is therefore recommended to use a current that stimulates the entire musculature if possible. Therefore, monophasic square-wave pulses with a pulse width of 100 ms are used. In the case of very severe atrophy, the pulse width can be extended up to 500 ms in the sense of classical paralysis treatment. The single pulses must be synchronized with the speech exercises by hand switch. The current is applied on motor threshold.

All other movement disorders (acute flaccid, ataxic, and spastic dysarthria) usually do not show an electrical degenerative response due to a lack of atrophy and can therefore be stimulated with normal biphasic faradic current (50 Hz/1 ms). This has the advantage that a tetanic contraction occurs, which does not have to be synchronized by hand switch. The stimulation is permanent throughout the exercise session. The current is applied on motor threshold.

▸ – In flaccid dysarthria, select rectangular current (monophasic) with 100 ms width and synchronize with speech exercises.

- In spastic and ataxic dysarthria, select a biphasic faradic current.
- Stimulate disturbed articulator during speech practice.

Choice of stimulation site:

Usually choose a monopolar electrode placement. The active electrode is placed on the disturbed articulator:

- Disturbed tongue movement: Hypoglossal nerve—floor of mouth (Figs. 12.1 and 12.2).
- Disturbed jaw closure: Trigeminal nerve—masseter muscles (Fig. 12.3).
- Disturbed lip closure: Facial nerve—facialis trunk (Fig. 12.4).

Speech exercises:

The speech exercises are performed over a treatment period of 30 min, during which the disturbed clusters identified with the help of diagnostics are repeated for 30s at a time under electrical stimulation at a metronome rate. If the patient articulates all clusters on one exhalation

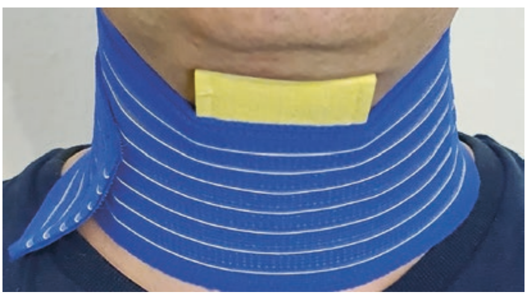

Fig. 12.1 Hypoglossal nerve—monopolar stimulation

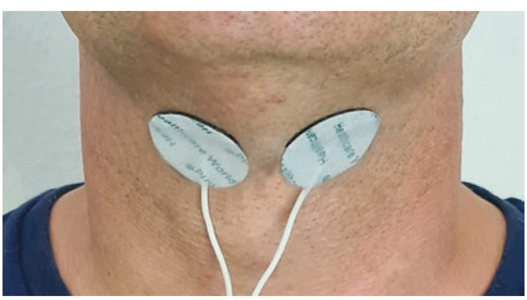

Fig. 12.2 Hypoglossal nerve – bipolar stimulation

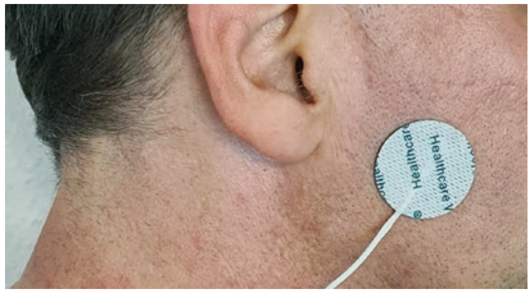

Fig. 12.3 Masseter muscles—monopolar stimulation

Fig 12.4 Facial nerve monopolar stimulation

correctly and at the speed of the metronome, the metronome beat is increased by one bpm, if one cluster or more is simplified or if the patient does not follow the beat, the metronome frequency is reduced by one bpm. Thus, with each breath, the metronome frequency is adjusted. After 30s of speech practice, there is a 30s pause. During this pause, the patient is asked to watch for possible errors in articulation or speech tempo during the next pass. For example, if the syllable /la/ is reduced to /a/ at a certain frequency (e.g., 110 bpm), the patient is asked to pronounce the /l/ as clearly as possible without slowing down. With this concentration on the disturbed movement, the articulation speed can usually be increased by 2–3 bpm without loss of clarity (e.g., to 112 bpm). Thus, because of the therapist's feedback, there is a greater effort on the part of the patient, resulting in an increased articulatory rate. With practice, this type of attentional focus on the disordered movement is no longer necessary for the required rate. The perturbed movement can now be produced at a higher rate (112 bpm) without effort. If attention is now directed once again to the disordered movement, the articulation speed increases again (e.g., 114 bpm). In sum, it can be said that like CIMT therapy [22] a correct movement of the affected musculature is "forced."

For some disturbed movements, visual feedback via a mirror can also be beneficial, e.g., "Please try to close your lips completely on the /b/ of /bla/ in the metronome beat".

Some patients find it difficult to keep the beat. This is often the case when they have never had a connection to music. In this case, the therapist can guide the patient's hand in time, tapping along with the beat and speaking along with the first syllables.

Goals of therapy according to the type of movement disorder:

- Spastic dysarthria: Increase the speed of articulation for the affected syllable while maintaining distinctness. In this movement disorder, the syllable /ʃla/ is almost always exclusively affected. Usually this is reduced to /ʃa/ because the tip of the tongue cannot lift at a sufficient speed.
- Atactic dysarthria: Retention of articulation speed with increasing metronome beat. Simplifications do not usually occur. Usually, all three syllables need to be trained.
- Flaccid dysarthria: The problem here is that two goals must be pursued: increasing the speed of articulation on the affected syllable while maintaining distinctness, as in spastic dysarthria, and avoiding fatigue. To train myasthenic symptomatology, it is often useful to shorten the exercise/pause ratio of 30s/30s (e.g., exercise/pause = 7s/20s) and to approach the whole 30s:30s ratio in small steps. This could be done, for example, by increasing the exercise and pause interval by 1 s each new hour of therapy until the 30s/30s ratio is reached.

In flaccid dysarthria, it is not uncommon for all test syllables to be affected. Any articulator may be disrupted. Unfortunately, treatment of velum paresis is not possible with this procedure, at least not using plate electrodes. The velum can only be electrically stimulated by a point electrode on the soft palate, which makes additional speech exercises impossible. However, since there is relatively little experience with intraoral electrical stimulation, this procedure should be used with caution. Testing of the syllable /amp/ is nevertheless important, for consideration of other measures.

In a single case study of a chronic dysarthric patient [5], it was shown that training within the alveolar articulation zone also has generalization effects on untrained clusters of the same articulation zone. The three given training and testing clusters represent the most important articulation or coarticulation movements and are sufficient for training most dysarthria. In languages where the given clusters do not occur or practically do not occur (for example, there are far fewer clusters in Japanese than in German or English), the clusters must be replaced accordingly by similarly articulated forms (e.g., /ʃla/by/ʃta/) only the choice of articulation zone is crucial here.

▶ – 30s practice then 30s break over 30 min.
- Disturbed syllable should be spoken in the metronome beat at the limit of what is possible (regarding frequency).
- Always give feedback during breaks.
- Practice at least three times a week.

Effectiveness:

In a pilot study by Kroker et al. [5] with eight chronic dysarthric stroke patients (at least 12 months post onset), it was shown that training according to this principle improved communication skills in seven of eight patients after 20 intensive sessions. The test included the abandonment of compensatory strategies such as spelling or the use of gestures (in the case of severe forms) as well as intelligibility when communicating with strangers (directory assistance) on the telephone.

12.6.1 Procedure According to *Pahn and Pahn*

Pahn and Pahn [23] transferred their findings, which they had acquired in connection with the therapy of laryngeal paresis [13], to dysarthric disorders. In this approach, the accommodation of the tongue muscles was first measured. Based on the obtained accommodation quotient (alpha value), the pulse width of the stimulation pulse was chosen, which was applied to the floor of the mouth. Triangular pulses of 10 ms–1000 ms (depending on alpha value) were used. The pulses were synchronized with speech exercises by hand switch. Pahn and Pahn [23] suggests training with fricatives and plosives. These should be selected by the therapist. A standardized scheme is not provided for this. Case studies are not available for the approach.

12.7 Diagnosis and Therapy of Voice Disorders

Severe voice disorders occur mainly in ataxic and flaccid dysarthria. Since the ataxic voice disorder is probably a miscompensation of articulation [14], treatment of the same could also have a positive effect on the voice. Usually, the patient tries to produce a halfway intelligible articulation with a lot of pressing. From their own experience, the authors can confirm this hypothesis. Patients with ataxic dysarthria achieve a much higher articulation speed of all syllables when they form a strongly pressed voice. However, similar effects can be achieved in a more voice-sparing manner with an unpressed increase in speech volume [4].

The voice disorder of flaccid dysarthria corresponds to vocal fold paralysis. At least this symptom could be diagnosed and treated like one. To avoid redundancy, we would like to refer here to the chapter of Schneider-Stickler [24] in this book. However, all forms of dysarthria can also occur entirely without a voice disorder.

A particular vocal symptom of flaccid dysarthria is that in some cases voiceless phonemes are produced voiced. Ziegler et al. [14] attribute this to an additional existing velum paresis, thus there is a lack of counterpressure above the vocal folds, which could influence phonation. At the same time, it should be noted that both the velum and the laryngeal muscles are mainly innervated by the vagus nerve and this type of disorder usually occurs after damage to the lower motor neuron. Thus, severe velum palsy also makes impairment of laryngeal function likely. It was shown in a study from Venketasubramanian et al. [25], that vocal fold paralysis is strongly correlated with palatal weakness. Thus, one could hypothesize that in flaccid dysarthria, a change from voiced phonation to voiceless produced under time pressure could occur under electrical stimulation of the vocalis muscle. Patients with spastic dysarthria with mild voice disorder could also possibly benefit from this type of therapy by gaining fine motor control of the vocalis muscle. Unfortunately, there are neither normative values nor therapeutic experiences to support this consideration.

Voice dysfunction is the leading symptom of hypokinetic dysarthria, but since there is sufficient evidence base for LSVT© [4] we do not want to specify otherwise here.

12.8 Case Study

A 73-year-old female patient presented at the day clinic of our institution. She suffered a left middle infarction three years earlier and a right middle infarction two years earlier. The reason for admission was depression. She was born in Italy and moved to Germany at the age of 22. She stated that her voice was bad and that she had therefore problems being understood since the stroke. She said this was especially difficult in contact with strangers, but also in her own family. She had seen an ENT specialist and had a written report of a hyperfunctional voice disorder. In the outpatient therapy, voice-typical exercises were carried out (for breathing, as well as for reaching a low position of the larynx). However, there had not been a satisfactory result for her. In fact, the voice still sounded somewhat hoarse in the initial examination, but in our view, this was not to be attributed to such a high pathological value. However, communication was still somewhat difficult, and the examiner had to ask more than once. However, the speech did not sound typically dysarthric, rather strongly colored by an Italian accent. The measurement with the three test syllables showed a simplification of the syllable /ʃla/ to /ʃa/ at 85 bpm without fatigue response. The /bla/ and /kla/ clusters scanned near normal. The findings were in favor of spastic dysarthria, which would have been expected given the location of the brain damage. She herself stated that the syllable /ʃla/ was virtually rare in Italian and therefore it was slowed. Therefore, we tested other syllables of the same articulation zone (e.g., /ʃta/) and got similar results. We agreed to train this articulation zone for 20 sessions and to check whether there was an increase in distinctness. To do this, we had the patient call directory assistance ten times and ask for different names in different cities. She received the correct phone number within 1 min in only one of the 10 cases.

The therapy started over 20 sessions with a frequency of five times/week for 30 min each. Stimulation was at the floor of the mouth with biphasic faradic current (1 ms/50 Hz/5,8 mA). We started with three syllables from the alveolar-alveolar articulation zone (/ʃla/, /ʃli//ʃta/). The arithmetic mean was initially 82 bpm. After 20 sessions, she had increased 100% to 164 bpm.

After therapy, she stated that she could speak much more clearly, which was also confirmed by her relatives. In the telephone test, she was able to improve significantly to 9/10 successful attempts. She stated that she had significantly improved her quality of life.

This example shows that dysarthria cannot always be diagnosed with certainty. The problem was probably that the patient used the term "voice" incorrectly and doctors and therapists were misled by this. Often this diagnosis becomes difficult when several influencing factors coincide (e.g., poor dental status, foreign accent, additional aphasia). The test of articulation speed proved to be very valuable in this case. The outcome of the therapy is truly impressive for the duration of the condition. While the improvement in motor skills and clarity are most likely due to the therapy, the gain in quality of life is not necessarily due to the speech success alone, as the patient also received psychiatric treatment at the same time.

12.9 Discussion

The strength of Dys-SAAR-thrietherapie (DST) lies primarily in the treatment of articulatory fine motor skills. Dysarthria, as mentioned at the outset, is the most common communication disorder and articulatory dysfunction is the most common symptom of dysarthria. Thus, this type of therapy finds meaningful application in a broad patient population. Initial study results show a promising outcome in the intensive setting after only 20 sessions. Compared to LSVT ©, DST offers the following advantages: An increase in intelligibility is achieved in LSVT © essentially by increasing speech volume. However, this is close to normal in many non-progressive dysarthric patients, so that an increase in speech volume would not only appear very unnatural, but also have a questionable effect overall. DST does not require any change in speech volume. Furthermore, LSVT © is completed after 16 sessions and the result is then achieved. DST may also be useful in a second or third intensive interval. However, it should also be noted that DST makes high demands on a patient's motivation. Most patients perceive the 30 min therapy as very strenuous, but usually achieve success quickly. Experience shows that an audible improvement in speech occurs when the rate of articulation increases by 20%. This is usually achieved after about 5–7 sessions.

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