CLASSIFICATION OF SCI REHABILITATION TREATMENTS

SCIRehab Project Series: The Speech Language Pathology Taxonomy

Wendy Gordan, MA, CCC-SLP¹; Dana Spivak-David, MA, CCC-SLP²; Viki Adornato, MA, CCC-SLP³; Beverly Dale, MA, CCC-SLP⁴; Rebecca Brougham, MA, CCC-SLP⁵; Amy C. Georgeadis, MS, CCC-SLP⁶; Julie Gassaway, MS, RN⁷

¹Craig Hospital, Englewood, Colorado; ²Mt. Sinai Medical Center, New York, New York; ³Carolinas Rehabilitation, Charlotte, North Carolina; ⁴Rehabilitation Institute of Chicago, Chicago, Illinois; ⁵Shepherd Center, Atlanta, Georgia; ⁶National Rehabilitation Hospital, Washington, DC; ⁷Institute for Clinical Outcomes Research, Salt Lake City, Utah

Received December 20, 2008; accepted January 22, 2009

Abstract

Introduction: Outcomes research for speech language pathology (SLP) interventions for acute traumatic spinal cord injury (SCI) rehabilitation in the US is difficult because of the lack of a treatment classification system (taxonomy).

Objective: To describe a taxonomy developed by speech language pathologists (SLPs) to examine the effects of SLP interventions on SCI rehabilitation outcomes.

Methods: The SCIRehab study uses practice-based evidence, a rigorous observational methodology that examines treatment processes without specifying or requiring specific therapeutic interventions. Speech language pathology lead clinicians and researchers at 6 US SCI centers developed a detailed SLP taxonomy documentation process that is comprehensive of SLP interventions for patients with SCI.

Results: The SLP taxonomy consists of 7 intervention categories that address deficits (speech production for patients with artificial airway, motor speech and voice, swallowing, cognitive-communication, and communication) and the associated exercises and tasks that patients perform. Time is recorded for each category, and supplementary information focuses on cueing needs and family involvement that helps to describe and guide intervention selection. The SCIRehab project is enrolling 1,500 patients with acute traumatic SCI at 6 inpatient rehabilitation facilities.

Conclusions: Speech language pathology taxonomy information is being captured for the SCIRehab patients who are referred for SLP services; this may be the first attempt to document the many details of the SLP rehabilitation process for patients with SCI in the US.

J Spinal Cord Med. June 2009;32(3):307–318

Key Words: Spinal cord injuries, Rehabilitation, physical; Speech language pathology, Taxonomy; Practice-based evidence; Tracheostomy; Ventilator; Dysphagia; Apraxia; Dysarthria

Please address correspondence to Julie Gassaway, MS, RN, Institute for Clinical Outcomes Research, 699 E. South Temple, Salt Lake City, UT 84102; p: 410 315 8091; f: 801 466 6685 (e-mail: jgassaway@isisicor.com).

This work was supported in part by grants from the National Institute on Disability and Rehabilitation Research (NIDRR), Office of Special Education Services, US Department of Education to Craig Hospital (grants #H133A060103 and #H133N060005), Mount Sinai School of Medicine (grant #H133N060027), National Rehabilitation Hospital (grant #H133N060028), Carolinas Rehabilitation (grant #H133A21943–16), Shepherd Center (grant #H133N060009), and Rehabilitation Institute of Chicago (grant #H133N060014).

This is the 6th in a series of 9 articles describing The SCIRehab Project: Classification of SCI Rehabilitation Treatments.

BACKGROUND

Approximately 11,000 people are hospitalized with a new spinal cord injury (SCI) each year in the US (1,2). Of patients admitted to SCI rehabilitation, 14% need ventilator (vent) assistance and 4% are discharged on a vent (3). The patient who receives mechanical vent experiences communication challenges due to the loss of the ability to vocalize. After discontinuation of the cuffed tracheostomy (trach) tube and vent support, deviant speech characteristics can still be evident. Speech impairments have been found to be most prevalent in the respiratory and laryngeal subsystems of speech production. Respiratory impairments may include shallow inspirations and/or decreased length and control of expiration, while laryngeal impairments may be evident

in prosodic disturbances related to rate, phrase length, stress patterns, and/or pitch and loudness variations. Some individuals display impaired function of the articulators. As a result, overall intelligibility has been perceived as mildly deviant when any of these aforementioned factors are taken into consideration (4,5). In addition, vocal cord paralysis/paresis may occur from peripheral nerve damage to the superior laryngeal nerve and/or recurrent laryngeal nerve during an anterior cervical fusion. If the patient undergoes traumatic endotracheal or trach tube placement, vocal cord paralysis/paresis may occur (6). When the vocal cords are weakened, the patient experiences voice impairments and closure of the vocal cords during swallowing may be compromised.

Commonly, dysphagia is associated with cervical SCI. Patients with higher-level cervical injuries requiring an anterior cervical fusion have an increased incidence of dysphagia. The incidence of dysphagia in patients with SCI has been found to range from 36% to 60% (6–9). Martin et al found dysphagia to be evident in patients after anterior cervical fusions, with dysfunctions and impairments, including prevertebral soft-tissue swelling; reduced pharyngeal wall movement; impaired upper esophageal sphincter (UES) resulting in impaired movement of the bolus through the UES; incomplete epiglottic deflection; and residue with thicker bolus consistencies after the swallow in the valleculae, pyriform sinus, and posterior pharyngeal wall (7). Logemann further describes reduced laryngeal elevation and anterior movement resulting in reduced closure of the airway entrance, possible oral stage problems, and a delay in triggering the pharyngeal swallows. These problems may result from trauma to peripheral nerves, pharyngeal swelling postoperatively, protrusion of bone graft or cervical hardware, and cranial nerve involvement with high-level cervical injuries (7,10).

Patients with cervical SCI also may experience esophageal perforations. Injury factors that would indicate a high index of suspicion include cervical SCI with hyperextension/hyperflexion, anterior surgical instrumentation/fusion, traumatic endotracheal intubation, and a penetrating injury (eg, gunshot wound). In these instances, the recommended diagnostic workup includes a barium swallow in supine or semireclined position, endoscopy, modified barium swallow study, and soft-tissue films of the neck (11).

Because the mechanism of SCI is most commonly motor vehicle accidents, falls, assaults, and sports mishaps, it is not surprising to find that rates of concurrent acute brain injury (ABI) range from 10% to 60% in these individuals (12–16). Recently, Macciocchi et al published findings that supported these statistics, finding that 60% of 198 persons with SCI also sustained a traumatic brain injury (17). Speech language pathologists (SLPs) frequently treat these patients for language and cognitive-communication impairments to facilitate

learning so that the patients can perform or direct their care program accurately. The ultimate goal is independence within the confines of the injury.

Cognitive deficits include difficulties with attention, concentration, memory, problem-solving, abstract reasoning, new learning, and executive functioning. Cicero et al define cognition to include “the discrimination between and selection of relevant information, acquisition of information, understanding and retention, and the expression and application of knowledge in the appropriate situation. Cognitive disability may be seen in reduced efficiency, pace and persistence of functioning, decreased effectiveness in the performance of routine activities of daily living (ADLs), or failure to adapt to novel or problematic situations” (18). Cicero et al summarized the published cognitive rehabilitation literature from January 1988 through August 1998 and provided evidence-based recommendations for the clinical practice of cognitive rehabilitation. A subsequent article published in 2005 reviewed cognitive rehabilitation research studies completed from 1998 to 2002 (19). Recommended practice standards were determined to include, in part, cognitive-linguistic therapies during acute and postacute rehabilitation for persons with language deficits secondary to left hemisphere stroke; specific interventions for functional communication deficits, including pragmatic conversational skills; and compensatory memory strategy training for persons with mild memory impairments from ABI. Recommended practice guidelines for persons with ABI during postacute rehabilitation included attention training (eg, varied stimulus modalities, complexity, and response demands), cognitive interventions for specific language impairments (eg, reading comprehension, language formation), and training in formal problem-solving strategies with application of the strategies to everyday situations and functional activities. Recommended practice options were the use of memory notebooks or other external aids to facilitate acquisition of specific skills and knowledge when applied directly to functional activities and verbal self-instruction, self-questioning, and self-monitoring to promote self-regulation.

Some patients who sustain a traumatic SCI but not a co-occurring ABI experience difficulty learning the necessary information to perform and/or direct their care after SCI. This may be related to pre-existing learning disabilities, attention deficit disorder, dementia, or emotional factors. Often, these patients present challenges for the health care provider because of their reduced ability to learn information efficiently. Wolfe et al discuss the issue of SCI education readiness, emphasizing the need to recognize teachable moments and to control the delivery of information (20). The authors state that learners with SCI in the inpatient rehabilitation setting require 5 to 10 practice repetitions to retain and apply new information. Adults learn best when their individual learning styles are identified and accommodated. It is not known how often in SCI rehabilitation patient learning

styles are assessed, but this assessment is critical so that the interdisciplinary team can offer the patient the best possible opportunity for learning.

In 1990, Folkins and Bleile applied the model of biological taxonomies to categorize phonetics, phonology, and speech motor control components in normal speech production. In doing so, they defined taxonomy as “the system of rules and units that structures any area of science” (21). This approach to categorizing components of language and cognition as separate entities or units has not been used widely. Language and cognition classification has evolved into a theoretical framework that is hierarchical with a strong interconnection among skills. Cognition, for example, has a theoretical basis built on a hierarchy of skills beginning with arousal, attention, speed of processing, organization, storage and retrieval of information, high-level reasoning, and problem-solving abilities (22,23). These skills are necessary to perform normal daily activities accurately and efficiently.

SCIREHAB PROJECT

Using a previously developed taxonomy for stroke rehabilitation (24) as a model, SCIR rehab speech language pathology (SLP) clinicians developed a taxonomy to provide a “system of rule and units” that would describe key interventions in the rehabilitation of patients with SCI who exhibit swallowing, speech, language, or cognitive-communication impairments. The SCIR rehab project, which uses the practice-based evidence methodology that capitalizes on variations in treatments not related to patient characteristics, is described in the first article in this series by Whiteneck et al (25). This article also describes the SCIR rehab hypotheses and research questions. To summarize, the SCIR rehab project is a 5-year research effort designed to determine which SCI rehabilitation interventions are associated most strongly with positive outcomes at 1 year after injury, controlling for patient differences. Over 2.5 years, the SCIR rehab project is enrolling 1,500 consecutive initial acute rehabilitation patients with traumatic SCI at 6 centers who consent to participate.

The purpose of this article is to describe a documentation system that includes detailed treatment information (taxonomy) developed by a group of SLPs in preparation for the SCIR rehab project. It consists of assessment and 7 intervention categories that address deficits (eg, motor speech, swallowing, cognitive-communication) and the associated exercises and tasks that patients perform as part of their treatment by SLPs. Time is recorded for each intervention category, and supplementary information focuses on cueing needs and family involvement that help to describe and justify intervention selection.

The iterative process used by each discipline in the SCIR rehab project to develop its taxonomy, along with the electronic documentation methods used, is described in the Gassaway article (second article in this series) (26).

SPEECH LANGUAGE PATHOLOGY TAXONOMY

The speech language pathology (SLP) intervention documentation system is consistent with the format used by other SCIR rehab disciplines: general session information, interventions and associated exercises and tasks performed in the session, and session-level variables (eg, patient/caregiver involvement and factors affecting the session). Table 1 provides an overview of all information included in the SLP documentation system for the SCIR rehab project. First, SLPs describe the session by type (group or individual), cotreatment with other disciplines if applicable, type of environment, and level of involvement of the patient and family. Factors that may limit the session (eg, pain, ventilator weaning) are identified. Next, SLPs identify assessment and/or 1 or more of the 7 SLP-specific interventions that address the patient's deficits. Cueing needs (Table 2) may contribute to SLP intervention selection. Tables 3 to 10 contain the “taxonomy” portion of the documentation and display each intervention's details. The amount of time spent per intervention is used as the measure of dosage.

Each SLP intervention category is described below. Some of the details (eg, needed level of cueing) are included in the documentation system to guide changes in intervention selection over time. Gassaway et al describe documentation elements that are used across most disciplines in the SCIR rehab project, including assistance needs (26). Speech language pathology identification of assistance needs, however, varies from how other disciplines define assistance, because it focuses on the need for verbal cueing to complete a task rather than on physical assistance.

The Functional Independence Measure (FIM) is a widely used scale intended to “measure what the person with the disability actually does, whatever the diagnosis or impairment, not what (s)he ought to be able to do, or might be able to do under different circumstances.” (27). The FIM describes patients' assistance needs (from person or device) to perform a functional activity. However, the FIM instrument does not include some SLP interventions such as, swallowing, voice, and speech. In addition, SLPs focus on aspects of cognition that are not included in FIM (orientation, attention, processing speed, pragmatics, and safety). Because SLPs are familiar with the nomenclature of the FIM, including minimum, moderate, and maximum descriptors of assistance needs, the SLP documentation system incorporates these terms to describe a patient's need for assistance or cueing. *Minimal assistance* is defined as requiring verbal cueing less than 25% of the time. This assignment is used if any cueing is required, even if the patient goes on to complete a task independently after receiving the initial cue. *Moderate assistance* is defined as requiring cueing 25% to 50% of the time, and *maximum assistance* is documented for a patient who needs verbal cueing more than 50% of the time. *Not applicable* is used when SLPs conduct a form of treatment during which the patient is passive, such as monitoring a patient's O₂ saturation level

Table 1. Speech Language Pathology Session Level Variables and Interventions

Session Level Variables	
<u>Session descriptors</u>	<u>Factors affecting the session^a</u>
Type	Pain
Group ^b	Spasticity
Individual	Involuntary bowel/bladder
Cotreating discipline(s), if applicable	Orthostasis
Environment	Autonomic dysreflexia
Quiet	Heterotopic ossification
Distracting	Fatigue
<u>Missed therapy information (if applicable)</u>	Contracture/deformity
Time missed (in minutes)	Respiratory status
Reason	Active ventilator weaning
Refused	Wound/wound vacuum
Patient not available/ready	Medical complications—other
Equipment or therapist not available/ready	Bed rest
Medical complication	Weight-bearing status
	Surgical precautions
<u>Patient/caregiver involvement</u>	Orthoses
Patient participation scale	Halo
None	Behavioral issue
Poor	Cognitive issue
Fair	Visual/hearing impairment
Good	Cultural issues
Very good	Positioning
Excellent	Refused
Not applicable	Equipment malfunction
	Psychosocial support
Family or caregiver participation	In-room isolation
Not present	
Observed session only	<u>Administrative information</u>
Received verbal instruction	Date
Return demonstration	Start time
	Patient name
	Therapist name
Interventions ^{c,d}	
Assessment/evaluation topics (Table 3)	Swallowing interventions/feeding trials (Table 7)
Education and patient/family understanding (Table 4)	Swallowing interventions/exercises (Table 8)
Tracheostomy tube and/or ventilator support interventions (Table 5)	Cognitive-communication interventions (Table 9)
Motor speech and/or voice disorder interventions (Table 6)	Communication interventions (Table 10)

^a Clinicians may select multiple factors from this list.

^b Group work is documented as “group as individual,” which requires documentation of patient-specific information for each member of the group.

^c Time spent on each intervention category is documented (in 5-minute intervals).

^d More than one intervention category may be documented for each session. Additional descriptors for each intervention are documented as specified in Tables 2 to 10.

when trialing a speaking valve or administering electrical stimulation to a patient’s face. Table 2 lists the descriptors for level of cueing associated with SLP interventions.

Another common element in most SCIR rehab discipline’s documentation is factors that effect the session. These factors, which may cause the therapist to alter a therapy session depending on the patient’s condition, are described in the Gassaway et al article (26). Cognition may affect a therapy session negatively; however, working on cognitive-communication issues may be a specific goal

of an SLP therapy session. Thus, SLPs only select cognition as affecting the session if cognitive-communication work is not a focus of the session. For example, if SLPs attempt to teach strategies related to leak speech or swallowing and the patient does not retain or follow the information, “cognitive issues” affect the session.

Assessment

Upon request from a patient’s physician, SLPs conduct an initial evaluation to gather baseline data on a patient’s

Table 2. Options for the Level of Cueing

Maximum (>50%)
Moderate (25%–50%)
Minimum (<25%)
Independent
Not applicable

clinical and functional status (Table 3). The SLP documentation for the SCIR rehab project includes time spent on assessment of specific topics, but because the assessment results are described in the medical chart, they are not included in this documentation. *Speech* refers to the evaluation of motor speech factors related to a trach or vent. Thus, assessment of a patient's appropriateness for a trach speaking valve, such as the Passy Muir valve, is a component of speech assessment. Also included in speech is the assessment of dysarthria/apraxia, which may be a result of neurological impairments, such as ABI. *Swallowing* assessments include bedside evaluation, fiberoptic endoscopic evaluation of swallowing, and modified barium swallow studies. The SCIR rehab project's SLPs are interested in examining swallowing evaluation methods used with the SCI population and will utilize the data to determine the optimal course for evaluating swallowing given a patient's level of functioning. *Cognitive-communication* assessment refers to appraisal of thought processes, including attention, orientation, organization/sequencing, recall and problem solving, insight, executive functioning, processing speed, and pragmatics. *Communication* refers to aspects of language, which include auditory comprehension, verbal expression, reading, and writing (impairment of which can comprise a patient's ability to express wants and needs), as well as the evaluation of appropriate alternative/augmentative communication systems.

Education and Patient/Family Understanding

Education is an integral part of all SLP therapeutic interventions. However, sometimes SLPs provide education about specific topics without having the patient practice or use the techniques or ideas being discussed. Thus, *education* is a separate SLP category used to document sessions that address speech, swallowing, cognition, or communication but do not involve physical practice of skills. Education varies significantly for speech factors related to trach or mechanical vent (eg, valve use, leak speech) and those of motor speech (eg, dysarthria, apraxia) and voice (eg, vocal hygiene); they are separate components of the education intervention in the SLP taxonomy (Table 4).

Speech language pathologists document the teaching strategy used and the learning outcomes for the patient and the family. Because skill mastery is an acquisition of information over several presentations or

Table 3. Assessment/Evaluation Topics

Speech
Swallowing–bedside evaluation
Swallowing–fiberoptic endoscopic evaluation of swallowing
Swallowing–modified barium swallow study
Cognitive-communication
Communication

practices (rather than an all or nothing phenomenon), entry options allow for recording progression over time.

Tracheostomy Tube or Ventilator Support Interventions

Speech therapy is often conducted with patients who have a trach and/or vent. Often, patients with a trach/vent are unable to phonate due to air escaping through their trach prior to passing up through the vocal cords. The *speaking valve (with) trach* or *speaking valve (with) vent* intervention option is selected when trials of the speaking valve occur during the SLP session. *Finger occlusion* includes a trial of trach plugging using a glove-covered finger to occlude the trach. The *plugging/capping/button* intervention option is selected when one of these methods is used to occlude the trach or trach site and allow for voice production when a patient has a cuffless or deflated cuff on their trach or a button maintaining patency of the stoma. *Leak speech* implements partial or full-cuff deflation to work on voicing attempts while the patient is on the vent. It is important to measure the tolerance of these interventions during a given session, because use of the speaking valve or of plugging/capping for increasing lengths of time may result in improved communication or earlier decannulation. The amount of time the patient tolerates the speaking valve or plugging/capping is recorded, along with whether the speaking valve or plugging/capping continues after the session.

Mouthing is utilized to work on verbal communication in the absence of voice, which may not be possible if the patient does not tolerate any of the aforementioned interventions. Addressing the mouthing of words may include cues to decrease the rate of speech or establish the topic of conversation and increase intraoral sounds to improve intelligibility.

Weakness/deconditioned/respiratory compromise is selected when SLPs work to improve vocal/respiratory strength and volume. This item is selected if the patient already tolerates a speaking valve or plugging (tolerance was not the focus of the session).

A number of compensation strategies and treatment techniques (Table 5) are used with patients who have trachs and/or vents to strengthen systems that lead to speech and to improve speech intelligibility. A *respiratory trainer*, which includes use of an apparatus (eg, incentive spirometer, PFlex inspiratory muscle trainer, expiratory

Table 4. Education and Patient/Family Understanding

Topics	Teaching Strategy	Patient Mastery	Family Level of Understanding
Speech–tracheostomy/ventilator	Verbal instruction	Verbalizes understanding	Verbalizes understanding
Speech–motor/voice disorder	Written instruction	Provides return demo correctly	Provides return demo correctly
Swallowing	Video	Partial learning	Partial learning
Cognition	Demonstration(s)	No evidence of learning	No evidence of learning
Communication	Other	Not applicable/none	Not applicable/not present

muscle trainer to strengthen respiration), will lead to speech with increased volume. *Breathing exercises/diaphragmatic breathing* works on deep breathing, paced breathing, lateral stretch, shoulder pinches, triple breath holds, air shifts, quick breaths, number counting, or exercises to strengthen the accessory neck muscles to improve adequate breathing for better phonation. Additional strategies and techniques include *coordination of respiration and phonation* to coordinate breathing with phonation attempts, *pacing/rate* to pace speech or decrease its rate for better understanding of spoken words, *overarticulation* to exaggerate oral-motor movements to better facilitate comprehension by the listener, and *speaking volume* to increase vocal effort or voice projection to increase volume.

Motor Speech and/or Voice Disorder Interventions

Motor speech disorders (apraxia and dysarthria) may occur in SCI patients with a concomitant ABI. Apraxia is caused by damage to the area of the brain responsible for planning orderly movements of the speech muscles and can result in the partial or total inability to initiate or sequence speech sounds in proper order, despite the fact that muscles of speech have adequate strength. Dysarthria is caused by paralysis, weakness, or inability to coordinate the speech musculature. It often results in speech that is imprecise, slow, and difficult to understand. The person with dysarthria also may have problems controlling the pitch, loudness, rhythm, and other voice qualities of their speech. In addition, patients

with SCI often have weakness, deconditioning, and/or respiratory compromise in the absence of trach or vent placement or a motor speech disorder. Voice disorders must be diagnosed by an otolaryngologist who is trained to identify specific vocal-fold pathology.

Various compensatory strategies and treatment techniques are used with patients who have a motor speech disorder, weakness/deconditioning/respiratory compromise, or vocal fold pathology to improve the production of speech and voice (Table 6). The SLP taxonomy for speech motor/voice disorders includes compensation strategies used in speech trach/vents work (*respiratory trainer, breathing exercises/diaphragmatic breathing, coordination of respiration and phonation, intelligibility/speech practice rate, and intelligibility/speech practice volume*), as well as others specific to voice disorders. *Vocal cord exercises* include a variety of exercises that address vocal strengthening and stretching by using a series of pitch changing sequences. *Lee Silverman Voice Treatment*, which focuses on patients' increasing their vocal volume, is a treatment technique that requires additional formal training for the SLP (28). *Oral motor exercises* strengthen and improve the range of motion of the lips, tongue, cheeks, and jaw. *Electrical stimulation* is used with patients experiencing facial weakness. *Apraxia drills* are used to improve a patient's production of sounds, words, or phrases through repetition or by having the patient read aloud the target sound/word/phrase. *Voice amplifier* is an electronic device that allows the patient's voice to be amplified. Often, this

Table 5. Tracheostomy Tube and/or Ventilator Support Interventions

Intervention ^a	Tolerance During Session ^b	Compensatory Strategies and Techniques
Speaking valve–tracheostomy	Longest no. of minutes tolerated	Respiratory trainer
Speaking valve–ventilator		Overarticulation
Finger occlusion	Did patient continue with speaking valve or	Breathing exercises/diaphragmatic breathing
Plugging/capping/button	capping after the session? Yes/No	Coordination of respiration/phonation
Leak speech		Pacing/rate
Mouthing ^b		Speaking volume
Weakness/deconditioning/ respiratory compromise ^b		Other

^a Each intervention is associated with a level of cueing (see Table 2).

^b Tolerance during session not included for mouthing and weakness/deconditioning/respiratory compromise

Table 6. Motor Speech and/or Voice Disorder Interventions

Disorder/Compromise ^a	Compensation Strategies/ Techniques
Apraxia	Respiratory trainer
Dysarthria	Breathing exercise/ diaphragmatic breathing
Weakness/deconditioning/ respiratory compromise	Coordination respiration/ phonation
Vocal fold pathology	Vocal cord exercises Lee Silverman Voice Treatment Oral motor exercises Electrical stimulation Apraxia drills Intelligibility/speech practice rate Intelligibility/speech practice volume Voice amplifier Other Not applicable

^a Each disorder/compromise is associated with a level of cueing (see Table 2).

is used in cases in which the patient may not be able to improve vocal volume with practice.

Swallowing Interventions

Dysphagia is a common disorder following a SCI and/or SCI/ABI, especially in the early stages of recovery. It often results from complications consequential to anterior cervical fusions, cranial nerve damage, and laryngeal damage resulting from emergency airway management, to name a few (10). If aspiration of saliva, food, and/or liquids occurs, it may increase a patient's risk for pneumonia. Dysphagia may be so severe that alternative means of nutrition, hydration, and medication management are necessary. Assessment and remediation of the

swallow by skilled SLPs may help to restore functional swallowing, without aspiration and without artificial means of nutrition, hydration, and medication management.

In the SLP taxonomy, information about dysphagia is separated into 2 categories: swallowing interventions/feeding trials and swallowing interventions/exercises.

Swallowing Interventions/Feeding Trials. The presence of an artificial airway is important, because it can alter the normal pressure in the trachea and reduce laryngeal elevation, disrupting the swallow function. Therefore, the trach status is documented (*cuff inflated or deflated [partial or total], cuffless trach, or capped trach*). Compensatory strategies/techniques are used to improve the patient's ability to swallow and reduce or eliminate aspiration and/or penetration of the bolus. Traditional compensatory strategies and techniques are listed in Table 6. Food consistency and liquid levels trialed are documented to quantify progression of oral intake over time.

The swallowing interventions/feeding trials category (Table 7) is selected when SLPs supervise the patient eating because she/he requires continued therapeutic intervention for reasons that include but are not limited to ensuring carryover of strategies and techniques, adapting the feeding plan because of cognitive-behavioral issues, assessing fatigue as it affects swallowing safety, and upgrading or maintaining diet or liquid consistencies.

Swallowing Interventions/Exercises. This category is used when SLPs teach the patient specific swallowing strategies and use exercises to strengthen and improve swallowing function. It may or may not include food or liquid trials in conjunction with swallowing exercises and techniques prior to the introduction of full meals. As above for feeding trials, information about the trach type, food consistency trialed, and liquid level trialed is documented. *Exercises* include the use of *deep*

Table 7. Swallowing Interventions/Feeding Trials

Tracheostomy Type ^a	Compensation Strategy/Technique	Food Consistency Trialed	Liquid Level Trialed
No tracheostomy	Alternate textures/liquids	Not applicable	Not applicable
Cuff inflation	Chin down	Pureed/dysphagia I	Ice chips
Cuff partial deflation	Effortful swallow	Mechanical soft ground/dysphagia II	Thin liquids
Cuff deflation with valves	Head turn	Mechanical soft chopped/dysphagia III	Nectar liquids
Cuff with full deflation	Limit size bolus	Soft	Honey liquids
Tracheostomy with no cuff	Mendelsohn maneuver	Regular	Free water protocol
Cap	Multiple swallows	Medications	
	Rate		
	Super supraglottic		
	Supraglottic		
	Positioning of patient		
	Positioning of bolus		
	Other		

^a Each tracheostomy type is associated with a level of cueing (see Table 2).

Table 8. Swallowing Interventions/Exercises

Tracheostomy Type ^a	Exercises	Compensation Strategy/Technique ^b	Food Consistency Tried	Liquid Level Tried
No tracheostomy	Deep pharyngeal neuromuscular stimulation	Alternate textures/liquids	Pureed/dysphagia I	Ice chips
Cuff inflation	Neuromuscular electrical stimulation ^b	Chin down	Mechanical soft ground/dysphagia II	Thin liquids
Cuff partial deflation	Oral motor exercises	Effortful swallow	Mechanical soft chopped/dysphagia III	Nectar liquids
Cuff deflation with valves	Pharyngeal strengthening	Head turn	Soft	Honey liquids
Cuff with full deflation	Thermal stimulation	Limit size bolus	Regular	Free water protocol
Tracheostomy with no cuff		Mendelsohn maneuver	Medications	Not applicable
Cap	Other	Multiple swallows	Not applicable	
		Rate		
		Super supraglottic		
		Supraglottic		
		Positioning of patient		
		Positioning of bolus		
		Other		

^a Each tracheostomy type is associated with a level of cueing (see Table 2).

^b Compensation strategy/technique is associated with neuromuscular stimulation only.

Table 9. Cognitive-Communication Interventions

Cognitive-Communication Deficit ^a	Activity Level	Material	SCI Topic ^b	Compensation Strategies/Techniques
Orientation	Simple/basic	Structured tasks	Skin	Internal strategies
Attention	Moderate	Functional tasks	Bowel/bladder	External strategies
Memory	Complex	Academic subjects	Transfers	Not applicable
Organization/sequencing	Cognitive support for learning	Vocational skills	Autonomic dysreflexia	
Processing speed		Community re-entry	Medications	
Problem solving/reasoning		SCI topics ^b	Other SCI topics	
Pragmatics		Other		
Safety/insight				
Executive functioning				
Other				

^a Each cognitive-communication deficit is associated with a level of cueing (see Table 2).

^b Spinal cord injury topic is specified only if material is designated "SCI topics."

Table 10. Communication Interventions

Type ^a	Activity Level	Augmentative Devices ^b
Auditory comprehension	Simple/basic	Not applicable
Verbal expression	Moderate	Alphabet board
Written expression	Complex	Picture board/communication book
Reading comprehension		Other low-technology devices
Alternative/augmentative communication (AAC) ^b		Adaptive equipment
		Electric augmentative equipment
		Speech programmed devices
		Computer-based AAC devices
		Amplifier
		Electrolarynx
		Other

^a Each type is associated with a level of cueing (see Table 2).

^b Augmentative device type is associated with ACC only.

pharyngeal neuromuscular stimulation, neuromuscular electrical stimulation, oral motor exercises, pharyngeal strengthening, thermal stimulation, and other. If *neuromuscular electrical stimulation* is selected, specific compensation strategies/techniques used in conjunction with it are identified. These traditional techniques are well documented in the literature (10) and listed in Table 8.

Cognitive-Communication Interventions

Addressing cognitive-communication deficits is an important component of rehabilitation of patients with SCI and a documented or suspected ABI. Some patients without a documented or suspected brain injury are identified as needing cognitive-communication support for learning of SCI-specific information. These patients typically include (but are not limited to) those with prior documented language and learning disabilities, attention deficit disorders, dementia, developmental delays, drug or alcohol abuse, or significant emotional issues that affect new learning. Speech language pathologists work with the patient, family, and team members to help the patient achieve his/her highest level of independence given their physical limitations and cognitive status.

The SLP taxonomy for cognitive-communication work (Table 9) includes the traditional range of cognitive processes and systems: attention, orientation, organization/sequencing skills, memory, problem-solving/reasoning, and executive functioning. In addition, the taxonomy includes speed of information processing, safety judgment and/or insight, and pragmatics.

For each cognitive-communication deficit addressed, such as memory, SLPs determine whether the therapy activity level is *simple*, *moderate*, or *complex* based on task level or the number of steps involved. The other option under activity level is *cognitive support for learning*, which is used for patients without a brain injury. *Simple activities* focus on basic orientation, therapist-directed use of a memory notebook, simple sustained attention for processing auditory/visual information, memory for brief

pieces of information (1 to 3 sentences), sequencing 3 to 5 steps of basic activities, and categorization. This level of complexity may include orientation tasks, attending for 30 minutes without redirection, recall of location of the patient's room, route finding in the facility, reading a clock and schedule, or ordering meals in the hospital. *Moderate activities* focus on both sustained and selective attention, memory for passages of 2 to 4 paragraphs in length with utilization of internal and external strategies, and concrete problem solving that involves both inductive and deductive reasoning. This level of complexity frequently addresses speed of information processing in conjunction with other areas. They include recall of the name and purpose of medications and stating of functional sequences of steps for self-care tasks (eg, problem-solving for routine situations in the patient's room or hospital environment, prospective memory tasks). *Complex activities* require the patient to recall and use numerous pieces of information to problem solve accurately, retain information for functional use, and plan multifaceted tasks. All complex activities require multiple steps or factors and are concrete and/or abstract. They may also include the ability to draw conclusions and make accurate inferences. In addition, higher-level attention, including attention to detail, self-monitoring, and error awareness, may be emphasized. Examples of tasks at this complexity level include planning a day with accurate estimation of time to complete tasks, following a recipe when cooking, performing an internet search to obtain information followed by sending an e-mail to convey the information, and leading a therapy group.

If a patient does not have a documented or suspected ABI but requires learning assistance because of difficulty retaining SCI information delivered in other therapies or by nursing, SLPs document *cognitive support for learning* in the activity level. The focus of *cognitive support for learning* is the application of learning strategies for tasks (repetition of and supplementing information previously presented by other rehabilitation

team members) related to SCI self-care. It is different from patient education, because the patient is involved in applying strategies to help himself/herself gain increased independence in directing or performing his/her care. For example, it may include review of SCI material followed by the patient's practicing effective verbalization of the materials or steps of an activity, such as changing a leg bag or using proper techniques for pressure relief in bed.

The material field in the SLP taxonomy category of cognitive-communication interventions identifies the type of task used to address specific cognitive-communication deficits in patients with a brain injury or learning deficits in patients without a brain injury. These tasks include *structured tasks*, *functional tasks*, *academic subjects*, *vocational skills*, *community re-entry skills*, and *SCI topics*. *Structured tasks* include activities that are completed for skill development. For example, paper/pencil tasks allow the patient to complete a task in a systematic ordered way with or without the assistance of the therapist. *Functional tasks* include real-life planning tasks that may or may not be applicable to the patient's immediate situation. For example, the patient may plan a pizza party for when she/he returns home. These tasks may emphasize the use of memory strategies for retention of information or address speed of information processing. *Academic subjects* include reading, writing, or listening tasks affected by cognitive-communication deficits. These activities are related to return to school or work. *Community re-entry* involves an outing outside of the rehabilitation facility where SLPs evaluate, implement, or reinforce the patient's use of strategies taught in therapy sessions. *SCI topics* is a learning session to introduce and/or review information about skin care, bowel/bladder management, transfers, medications, etc, regardless of strategies used to help the patient retain the information.

After documenting the activity level and material, SLPs have the option to document the type of compensation strategies the patient used. *Internal strategies* include visualization, repetition with emphasis on error-free learning, etc, and *external strategies* focus on the use of a memory notebook, checklist, written schedule, etc. If no compensation strategies are used, SLPs document *not applicable*.

Communication Interventions

Communication skills in patients with SCI can be affected by language-based disorders caused by an ABI. Communication skills allow patients to understand and express their basic needs and wants, direct and understand their care, complete new learning related to SCI information, and participate in functional daily living activities. Communication types in the SLP taxonomy include *auditory comprehension*, *verbal expression*, *reading comprehension*, *written expression*, and *alternative/augmentative communication* (Table 10). *Auditory comprehension* includes such items as following directions, answering

yes/no questions, and having the ability to understand conversation. *Verbal expression* includes naming objects and photos, performing repetition, producing automatic sequences, expressing basic needs and wants, verbally directing care, and participating in conversational tasks. *Reading comprehension* involves silent or out-loud reading from word level to multiparagraph or full-page text. *Written expression* involves writing, ranging from tracing and copying to writing serial sequences and forming words, sentences, and paged text.

Selecting and training the patient in *alternative/augmentative communication* is a service that SLPs may provide to patients with SCI, because trachs and/or vents typically prohibit verbal communication. Patients with motor speech or other voice disorders may also benefit from alternative/augmentative communication. Although there is a wide variety of alternative/augmentative communication systems, modes of accessibility, and levels of technology, the SLP taxonomy includes such options as low-tech devices (eg, alphabet board, photo board, communication book) and basic systems (eg, eye blinks, thumbs up/down). Other broadly used options include electric augmentative equipment (scanners), speech programmed devices, computer-based devices, and adaptive equipment. A voice amplifier and electro-larynx are used occasionally.

DISCUSSION

Development of a comprehensive SLP taxonomy for treatment of dysphagia, speech, language, and cognitive-communication disorders in patients having SCI with or without a concomitant ABI presented some unique challenges. The areas of speech and swallowing fit easily into the taxonomy structure because they are somewhat concrete in nature. Speech intervention in the presence of a trach tube and/or vent is clearly different from a speech intervention for a motor speech or voice disorder. The specific intervention techniques also were straightforward to list because they are a standard component of formal SLP textbooks (29–31). For example, a supraglottic swallow is taught in the same manner to each patient.

The goal of any interventions taxonomy is to have a clear differentiation and definition of each category of intervention. This became difficult during the development of the cognitive-communication and communication portions of the taxonomy. There was less delineation because these 2 broad categories have a tremendous amount of overlap. In addition, learning research tells us that multimodality approaches are best when teaching new information. Thus, an intervention becomes more blended when, as often occurs, several techniques may be used at one time to address multiple cognitive and/or communication deficits. For example, SLPs may address orientation and attention deficits simultaneously during a logbook review task; the primary goal is orientation, and attention is a secondary goal. In another example, the patient may practice tolerance and use of a speaking

valve, which is the primary therapy goal. However, SLPs also may use this treatment time to have the patient verbalize orientation information, which is the secondary goal. In both of these examples, the therapist makes a clinical judgment as to what portion of the therapy time was spent on each of the 2 intervention categories.

For cognitive-communication therapy, a hierarchical approach was developed. First, the difficulty of the task is identified by activity level (simple, moderate, or complex). Defining simple, moderate, and complex activities required general guidelines so that all SLPs documented the difficulty level consistently. However, even with guidelines, there is room for interpretation and each therapist may deviate slightly in the identification of a task as simple, moderate, or complex. After the level of difficulty is identified, each task is characterized further as structured (eg, skill development) or functional, which we termed “material.” Additional material selections include academic skills, vocational skills, community re-entry, and SCI topics.

Documenting the amount of cueing needed for a cognitive-communication intervention as a whole did not coincide with levels of cueing that therapists provide for components of the intervention. A patient may progress from requiring a high level of cueing to a lower level (or independence) within a cognitive-communication deficit (for example memory); however, the level of cueing required for a more complex cognitive-communication task, such as problem solving, may be different. Thus, the SLP documentation system associates cueing needs with *each* cognitive-communication deficit identified, rather than with the session as a whole.

Speech language pathologists often incorporate the learning of SCI topics into a therapy session. When the SLP goal is to address cognitive-communication deficits by reinforcing the patient’s learning of the targeted SCI topic, it is documented in the cognitive-communication category by specifying “SCI topic” as the material used.

An additional challenge encountered during the development of the SLP taxonomy was how to document intervention information for patients who experience difficulty learning information about their SCI (eg, nursing care issues, transfers) but do not have a diagnosed or suspected ABI. These patients are seen by SLPs as a result of a referral when the rehabilitation team becomes frustrated with the patient’s inability to learn information taught in therapy sessions. However, SLP referrals and practice vary across SCIR rehab centers, ranging from screenings and subsequent recommendations to the rehabilitation team to extensive evaluations and extended treatment. The SLP goal when working with these patients is to ensure greater independence and better long-term outcomes. Cognitive support for learning is reserved as an “activity level” for patients without a brain injury who need learning strategies for specific SCI care content. Treatment sessions may provide a setting in which the patient is given the opportunity to repeat

information in smaller segments. Repetition may result in decreased anxiety and improved storage, retrieval, and application of information. Speech language pathologists can identify individual patient learning style and education preparedness; incorporation of these into the session facilitates patient learning and retention.

CONCLUSIONS

In the SCI population, there is a broad spectrum of SLP treatment needs that may range from treatment of severe deficits to only temporary limitations. Collaborative efforts of the SCIR rehab SLP clinicians to develop the taxonomy provided the opportunity for extensive sharing of practice patterns and treatment methods. The clinicians were able to identify multiple site-to-site consistencies in treatment but also learned about differences in practice patterns. The diverse treatment approaches needed to be consolidated into a practical number of taxonomic categories, and, through collaborative efforts, the comprehensive SLP taxonomy for SCI rehabilitation was developed. The use of the SLP treatment taxonomy in SCIR rehab data collection provides consistent categorization and quantification of intervention information, which will begin to identify the amount of involvement SLPs have with patients with SCI and substantiate the need for SLP intervention in quality SCI rehabilitation care.

REFERENCES

1. National Spinal Cord Injury Statistical Center. *Spinal Cord Injury Facts and Figures*. Birmingham, AL: University of Alabama; 2008.
2. Lasfargues J, Custis D, Morrone F, Carswell J, Nguyen T. A model for estimating spinal cord injury prevalence in the United States. *Paraplegia*. 1995;33(2):62–68.
3. National Spinal Cord Injury Statistical Center. *Annual Report of the Model Spinal Cord Injury Care Systems*. Birmingham, AL: University of Alabama; 1999.
4. MacBean N, Ward E, Murdoch B, Cahill L, Solley M, Geraghty T. Characteristics of speech following cervical spinal cord injury. *J Med Speech-Lang Pathol*. 2006;14(3):167–184.
5. Hoit J, Banzett R, Brown R, Loring S. Speech breathing in individuals with cervical spinal cord injury. *J Speech Hear Res*. 1990;33(4):798–807.
6. Winslow C, Meyers A. Otolaryngologic complications of the anterior approach to the cervical spine. *Am J Otolaryngol*. 1999;20(1):16–27.
7. Martin R, Neary M, Diamant N. Dysphagia following anterior cervical spine surgery. *Dysphagia*. 1997;12(1):2–8.
8. Frempong-Boadu A, Houten J, Osborn B, et al. Swallowing and speech dysfunction in patients undergoing anterior cervical discectomy and fusion: a prospective, objective preoperative and postoperative assessment. *J Spinal Disord Techn*. 2002;15(5):362–368.
9. Abel R, Ruf S, Spahn B. Cervical spinal cord injury and deglutition disorders. *Dysphagia*. 2004;19(2):87–94.
10. Logemann J, ed. *Evaluation and Treatment of Swallowing Disorders*. Austin, TX: Pro-Ed; 1998.

11. Dahlberg C, Lanig I, Kenna M, Long S. Diagnosis and treatment of esophageal perforations in cervical spinal cord injury. *Top Spinal Cord Inj Rehabil*. 1997;2(3):41–48.
12. Davidoff G, Morris J, Roth E, Bleiberg J. Cognitive dysfunction and mild closed head injury in traumatic spinal cord injury. *Arch Phys Med Rehabil*. 1985;66(8):489–491.
13. Davidoff G, Roth E, Richards J. Cognitive deficits in spinal cord injury: epidemiology and outcome. *Arch Phys Med Rehabil*. 1992;73(3):275–284.
14. Davidoff G, Thomas P, Johnson M, Berent S, Dijkers M, Doljanac R. Closed head injury in acute traumatic spinal cord injury: incidence and risk factors. *Arch Phys Med Rehabil*. 1988;69(10):869–872.
15. Wilmot C, Cope D, Hall K, Acker M. Occult head injury: its incidence in spinal cord injury. *Arch Phys Med Rehabil*. 1985;66(4):227–231.
16. Steudel W, Rosenthal D, Lorenz R, Merdes W. Prognosis and treatment of cervical spine injuries with associated head trauma. *Acta Neurochir Suppl*. 1988;43:85–90.
17. Macciocchi S, Seel R, Thompson N, Byams R, Bowman B. Spinal cord injury and co-occurring traumatic brain injury: assessment and incidence. *Arch Phys Med Rehabil*. 2008;89(7):1350–1357.
18. Cicerone KD, Dahlberg C, Kalmar K, et al. Evidence-based cognitive rehabilitation: recommendations for clinical practice. *Arch Phys Med Rehabil*. 2000;81(12):1596–1615.
19. Cicerone KD, Dahlberg C, Malec JF, et al. Evidence-based cognitive rehabilitation: updated review of the literature from 1998 through 2002. *Arch Phys Med Rehabil*. 2005;86(8):1681–1692.
20. Wolfe D, Potter P, Sequeira K. Overcoming challenges: The role of rehabilitation in educating individuals with SCI to reduce secondary conditions. *Top Spinal Cord Inj Rehabil*. 2004;10(1):41–50.
21. Folkins J, Bleile K. Taxonomies in biology, phonetics, phonology, and speech motor control. *J Speech Hear Disord*. 1990;55(4):596–611.
22. Sohlberg M, Mateer C, eds. *Introduction to Cognitive Rehabilitation Theory and Practice*. New York: Guilford Press; 1989.
23. Sohlberg M, Mateer C, eds. *Cognitive Rehabilitation: An Integrative Neuropsychological Approach*. New York: Guilford Press; 2001.
24. Hatfield B, Millet D, Coles J, Gassaway J, Conroy B, Smout R. Characterizing speech and language pathology outcomes in stroke rehabilitation. *Arch Phys Med Rehabil*. 2005;86(12 Suppl 2):S61–S72.
25. Whiteneck G, Gassaway J, Dijkers M, Jha A. New approach to study the content and outcomes of spinal cord injury rehabilitation: The SCIRehab Project. *J Spinal Cord Med*. 2009;32(3):251–259.
26. Gassaway J, Whiteneck G, Dijkers M. Clinical taxonomy development and application in spinal cord injury research: The SCIRehab Project. *J Spinal Cord Med*. 2009;32(3):260–269.
27. IRF-PAI Training Manual. Section III - The FIM instrument: Underlying principles for use of the FIM™ UB Foundation Activities, Inc; 2004.
28. Wenke R, Theodoros D, Cornwell P. The short- and long-term effectiveness of the LSVT(R) for dysarthria following TBI and stroke. *Brain Inj*. 2008;22(4):339–352.
29. Ashley M, Krych D, eds. *Traumatic Brain Injury Rehabilitation*. Boca Raton, FL: CRC Press, Inc; 1995.
30. Parenté R, Herrmann D, eds. *Retraining Cognition: Techniques and Applications*. Gaithersburg, MD: Aspen Publishers, Inc; 1996.
31. Holland A, ed. *Language Disorders in Adults*. San Diego, CA: College-Hill Press, Inc; 1984.