ORIGINAL ARTICLE

ToCUEST: a task-oriented client-centered training module to improve upper extremity skilled performance in cervical spinal cord-injured persons

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Objectives: Given (a) the importance of upper extremity skill performance in persons with cervical spinal cord injury (C-SCI), (b) the limited number of studies on arm hand functioning in C-SCI and (c) the discrepancy between the importance of client centeredness and the lack of a theoretical framework and practical guidelines on how to apply client centeredness into practice, the aim of the present study is to (1) develop a training concept in which rehabilitation of the upper extremity focuses on patient's needs and wishes and (2) to put this concept into practice for tetraplegic persons.

Methods: The training concept contains two main components. The client-centered component includes both extracting individual goals and defining and objectifying these goals. The task-oriented component incorporates a task analysis and the composition of an individual training program.

Results: A task-oriented client-centered training aimed at improving upper extremity skilled performance in tetraplegic persons is described step by step. The Canadian Occupational Performance Measure is used to identify patient's specific needs. The Goal Attainment Scale is applied to define and objectify individual goals. A task analysis is essential to map limiting and facilitating factors of the person, the task and the environment and to identify which aspects should be trained. An individual task-oriented training program is composed, based on principles of motor learning and training physiology and the use of assistive devices. Each step is explained and illustrated using a case example.

Spinal Cord (2011) **49**, 1042–1048; doi:10.1038/sc.2011.52; published online 31 May 2011

Keywords: client-centered; goal setting; task-oriented rehabilitation program; upper extremity; tetraplegia

Introduction

Persons with a cervical spinal cord injury (C-SCI) report that rehabilitation of the upper extremity is a top priority.¹ A small gain in upper extremity skilled performance may lead to large differences in self-management and quality of life.² However, in general, rehabilitation of SCI persons is characterized by an overall approach in which patients receive an extensive package of care aimed at, among others, arm hand skilled performance. The focus of the training is mostly decided on by the team, depending on the lesion level and the lesion completeness. Despite the importance of arm hand skilled performance, a recent review on training of arm hand functioning in C-SCI reveals a limited number

of studies in this area.³ Furthermore, the importance of the task specificity of the training, in line with general principles of motor learning, is reported.³ Owing to both the wide variety of upper limb activities that exists and the importance of the specificity of the training, it is impossible to train all upper limb activities. A client-centered approach that focuses on specific activities that are important to the patient may solve this problem.³

Client-centeredness and goal setting have emerged as important components in rehabilitation, leading to many advantages like increased motivation and increased efficiency and effectiveness of rehabilitation.⁴ Although many rehabilitation teams claim to apply patient-centered care, that is, to incorporate the patient's own needs and wishes in the rehabilitation process, they tend to direct patients in their goal setting, more or less excluding them from the decision-making process.^{4–6} In the rehabilitation of persons with SCI, the Needs Assessment Checklist, which is an

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Received 30 October 2010; revised 24 February 2011; accepted 22 March 2011; published online 31 May 2011

Figure 1 Training concept. COPM, Canadian Occupational Performance Measure; GAS, Goal Attainment Scale.

instrument that provides an overview of different goals according to the lesion level, has been developed.⁷ This instrument helps to define goals and to evaluate rehabilitation outcome, but it does not offer the opportunity to take into account personal wishes and preferences. Furthermore, it may not detect the small changes that are important to the patient. Literature stresses the importance of using client-centered outcome measures in the assessment of persons with tetraplegia, but also the need to develop adaptable rehabilitation programs to ensure that individual requirements are addressed.^{8,9} Also, a lack of theoretical frameworks to formalize client-centered rehabilitation approaches,^{8,10} a lack of guidance on how to apply goal-setting theories into clinical practice⁶ and the need to obtain evidence about their efficacy are reported.^{7,11}

Whereas some research in SCI focuses either on client-centeredness and goal setting or on general training programs of arm and hand, both principles are merged in the present study. The aim of the present study is (1) to describe a concept in which different components of a task-oriented client-centered training to improve arm hand skilled performance are integrated and (2) to put this concept into practice by describing guidelines on how to apply the task-oriented training to improve upper extremity skilled performance in daily practice in persons with C-SCI using a case example.

The task-oriented client-centered training concept

Figure 1 gives an overview of the different aspects of the training concept.

First, the concept stresses the importance of client-centeredness, in which rehabilitation starts from the patient's own needs and wishes, explicitly incorporating elements that guarantee the patient's involvement in the decision-making process. Second, the task-oriented training is stressed, in accordance with theories of motor learning.

Table 1 Introduction case example

Patient	TS, woman 45 years; traumatic SCI, due to a fall; ASIA score: motor C6C6, sensory score C7C7; AIS C; UEMS (right) 19, (left) 13
Functional status (5 months after injury)	Able to make transfers independently and dress herself with easy cloths (no zip or buttons); she has difficulties in holding and manipulating objects
Problem	Experiences problems at home on skills she never trained on
Plan of action	The occupational therapist used the Canadian Occupation Performance Measure to identify TS's major problems, resulting in the following list in order of importance (with score): eating with knife and fork, including cutting food (10); styling her hare (9); applying make-up (8); negotiating stairs (8); writing (7)
Treatment goals	Based on the list, the team, in concert with the patient decided that the following activities were to be trained: eating with knife and fork, styling the hair and applying make-up

Abbreviation: AIS, ASIA Impairment Scale; SCI, spinal cord injury; UEMS, Upper Extremity Motor Score.

Also, the modularity of the therapy is stressed in this concept, allowing to train on changing needs throughout the patient's life.

The components of this training concept will be further elaborated and applied in practice through a Task-oriented Client-centered Upper Extremity Skilled performance Training (ToCUEST) module for C-SCI persons. This will be explained in the section below.

ToCUEST module

Client-centered

As shown in Figure 1, the client-centered component includes extracting the individual goals as well as defining and objectifying these goals.

Step 1: Extracting individual goals. Donnelly *et al.*⁸ described the use of the Canadian Occupational Performance Measure (COPM) in SCI. However, their study was mainly performed to get insight into the nature of problems and treatment goals of SCI persons. In ToCUEST, the COPM is used to identify the client's most problematic activities, which are translated into individual treatment goals and used to compose an individual training program. As the patient's wishes may not always be realistic, a multidisciplinary team discusses, together with the patient, whether the goals chosen are feasible and realistic. Table 1 introduces a C-SCI person who will start with the ToCUEST module.

Step 2: Defining individual goals. Defining and setting individual goals are the key components of goal planning and enhance skill acquisition.⁷ However, objectifying goals is difficult because general assessment tools do not always cover these individually chosen tasks.¹² The use of the Goal Attainment Scale (GAS), which is an instrument that enables a rehabilitation team to set SMART (Specific, Measurable, Achievable, Realistic and Timed) goals,¹² accommodates the

need to (1) specify goals to improve motor learning and (2) objectify goals in order to be able to evaluate whether the individual goals have been achieved after training. To improve the client centeredness, in ToCUEST patients are involved in defining their GAS score (see Table 2). Furthermore, the patient's preferences on how his/her goal has to be achieved are important factors to be taken into account in the next steps of the training, that is, in the task analysis and the composition of the training program.

Task-oriented

The task-oriented component consists of a task-oriented task analysis to compose a functional task-oriented training program that combines principles of training physiology, motor learning and the use of assistive devices (see Figure 1).

Step 3: Task analysis. In ToCUEST, the task analysis, for the greater part, is based on the dynamic system theory,

Table 2 Goal Attainment Scale score of TS

Goal	To eat with knife and fork
+2: much better than expected	Eat using a knife and fork (without adaptation); able to cut steak
+1: better than expected	Eat using an adapted knife and fork; able to cut steak
0: expected outcome	Eat using an adapted knife and fork; able to cut potatoes
-1: less than expected	Eat using an adapted knife and fork; unable to cut food
-2: much less than expected/ current level of performance	Eat using an adapted fork ^a ; unable to cut food

^aTS indicated she did not mind using cutlery with visible adaptations. She preferred to be able to cut her meat using an adapted knife, rather than using a normal knife and only being able to cut her potatoes.

according to which skill acquisition is the result of a proper interaction between different factors of the persons, the task and the environment.¹³ Each factor contributes to the ability or inability to perform a task. An overview of the different factors that are used in the training concept is shown in Figure 2. This figure also illustrates that these factors may be linked to the International Classification of Functioning Disability and Health (ICF).

Table 3 contains the task analysis form specifically for C-SCI persons, incorporating the most important factors for C-SCI persons. Whereas the patient for the greater part determines which task will be trained, the occupational therapist and the physiotherapist perform the task analysis, which stimulates a joint and interdisciplinary approach. They decide which factors are limiting or facilitating for the chosen task and which factors are trainable.

Step 4: Composition of the training program. The ToCUEST program is focused on activity level and varies, depending on whether factors related to the person, the task or the environment are targeted. Even though the training program is individually tailored, it should be based on (a) principles of training physiology,¹⁴ (b) principles of motor learning¹³ and, if needed, (c) the use of assistive devices (see Figure 1). Furthermore, training parameters regarding duration and frequency are well defined and the modularity of the training program is stressed. Merging these elements in training, the expertise of both physiotherapists and occupational therapists are combined into a common framework. The different elements will be explained in the following section and are illustrated in Table 6.

Principles of training physiology

Table 4a gives an overview of the main principles of training physiology. The principles of the repetitive maximum^{14,15}

Figure 2 The task-oriented client-centered task analysis linked to the ICF (International Classification of Functioning Disability and Health) contributing factors to skill performance.

Table 3 ToCUEST task analysis form of TS

Goal	Factors	Eating with knife and fork		Subtask: cutting with knife	
		+/-	Therapy	+/-	Therapy
Person	Muscle: strength(S)/endurance (E)	-	√	-	√:Strength (10 repetitions × 3 sets)
	Muscle group				
	ROM: articular				
	ROM: muscle flexibility				
	Co-ordination	-	√		
	Sensibility ^a	-			
	Pain				
	Condition	+			
Task	Motivation	+			
	...				
	Task category				
	Complexity				
	Speed				
	Task prerequisites: sitting balance,...				
Environment	Skill components: reaching, grasping, releasing, holding, transporting, manipulating	-	√: Manipulating		
	...				
	Physical environment				
	Object features	-	√: Adapted knife		
	Context				
	Location				
	Social environment				
	Cultural environment				

Abbreviation: ToCUEST, Task-oriented Client-centered Upper Extremity Skilled performance Training.

+, facilitator; -, barrier; √, to be trained.

^aAlthough the sensibility was a barrier, the therapists decided not to train specifically on this. They rather decided that dynamic strength should be trained to enable TS to cut the food with the knife. They also decided to train dynamic strength separately from practicing on manipulation of the utensils. The therapists started training the skill component 'manipulating' using adapted utensils.

are used as guidance in load and number of repetitions. These parameters should be chosen, based on the task analysis, depending on whether muscle strength or muscle endurance is the limiting factor to perform a specific task. In general, muscle strength improvement is obtained using the 'high resistance and low repetition' principle. Endurance strength is obtained using the 'low resistance and high repetition' rule.^{14,15} With regard to principles of training physiology in SCI, the general instructions for muscle training, in accordance with the guidelines of training physiology,¹⁴ are used in ToCUEST and presented in Table 5. However, therapists should take into account the total load of the program, depending on how many muscle groups are involved and how many repetitions should be performed. This was decided based on the findings of (a) Jacobs and Nash,¹⁶ who report that recommendations for endurance and strength training in SCI persons do not vary substantially from the advice offered to the general population, but the caregivers should be aware of the risk related to systemic dysfunction; (b) Taylor *et al.*,¹⁵ who report that the guidelines for progressive resistance training are applicable for many patients with muscle strength deficits and (c) other literature reporting a resistance training regime in SCI persons with loads between 60 and 75% of 1RM with 8–12 repetitions. However, the latter was based on a training program for the entire upper extremity muscle mass.¹⁷

Principles of motor learning

The general principles of motor learning, as shown in Table 4b, are applicable for SCI persons. However, different strategies should be used depending on the lesion level and completeness of the lesion. Freeman-Somers¹⁸ reported the following specific functional training strategies for these patients, that is, (a) building 'a foundation of movement skills' (associated with the task prerequisites and skill components in the training concept), (b) breaking down activities into their components (associated with the complexity of the task), (c) making tasks easier (related to the object features) and (d) learning skills in reverse order.

Assistive devices

As shown in Figure 1, the third pillar of the training concept is to provide an assistive device or alter object features to enable persons to perform the task chosen. However, using a new device or altering environmental factors does not automatically lead to skill acquisition. ToCUEST provides instructions and training to handle the new devices as a part of the motor learning process to achieve skill acquisition.

Duration and frequency of training program

According to the training concept (see Figure 1), training parameters like duration and frequency should be chosen based on the task analysis. In the ToCUEST module the

Table 4 Training principles used in the Task-oriented Client-centered training concept

(a) Training physiology	(b) Motor learning
Repetitive maximum	Context specificity
Progression	Whole versus part practice
Overload	Distribution practice
Specificity	Random practice
Functional	Overlearning
	Variability
	Feedback and guidance
	Stages of motor learning

duration has been set at 8 weeks with a frequency of three times a week and with a mean of half hour training for each task. First, although literature is equivocal on the duration of training, 8 weeks of training is in line with literature findings on both principles of motor learning and training physiology. Second, because varying the duration and intensity of treatment for each individual in relation to these two principles is difficult to organize in clinical practice. Furthermore, most SCI persons may already follow a muscle-training program, although not aimed at specific skills, to maintain physical fitness and muscle strength and endurance. Therefore, 8 weeks additional muscle training is assumed to suffice (see Table 6).

Modular

Persons with SCI may experience different needs once they finish active rehabilitation and live back in the community.⁹ Even more, SCI is a chronic illness and these patients encounter changing needs throughout their lives.⁵ ToCUEST is offered as a training module. This enables inpatients to participate. But also patients who finished their active rehabilitation phase and who experience new specific needs related to upper extremity skills are eligible to participate.

Step 5: Evaluation. The difficulty in client-centered therapy is to compare the outcome of individual goals and individual training programs inherent to client-centered care, and to objectify whether progression has been made. This requires the use of specific outcome measures to bridge the gap between client-centered therapy and evidence-based practice in which objective measures are needed. Evaluating objective improvement and evaluating patient's perception of the skilled performance both provide useful information.

In ToCUEST, the COPM in combination with the GAS is used to evaluate the individually chosen tasks. The COPM is used to measure subjective changes, that is, the patient's perception, with the Satisfaction score (How satisfied are patients?) and the Performance score (How do patients judge their own performance?) and has been tested as to its reliability and validity.¹² The GAS is used to evaluate the improvement with the objectively defined goals and has proven reliable, valid and sensitive.¹²

Next to the evaluation of individual tasks, also standardized measures so as to arm hand-skilled performance in persons with tetraplegia are used. The Functional

Table 5 Principles of training physiology

	Muscle strength ($< 1'$)	Muscle endurance ($> 1'$)
Load	70–90% of 1RM	$< 65\%$ of 1RM
Number of repetitions	8 to 12	> 12 (up to 40 with very low load)
Number of sets	3	3
Rest period between sets	Enough rest ($\geq 1'$)	Enough rest ($\geq 1'$)
Number of sessions per week	3	3

Abbreviation: RM, repetitive maximum.

Independence Measure or the Spinal Cord Independence Measure and the Quadriplegia Index of Function are used to measure the level of complex activities; the Van Lieshout Test is used to measure the level of basic activities^{2,19} (see Table 7). This enables therapists to report on general improvement with possible generalized effects of the training and to compare the general level of performance at the level of both basic and complex activities.

Discussion

Based on the importance of upper extremity skilled performance in persons with C-SCI,¹ a limited number of studies on arm hand functioning,³ the importance of client-centeredness,⁵ and a lack of theoretical framework and practical guidelines on how to apply client-centeredness into practice,^{6,10} the following aims were addressed: (1) to present a framework to train individual chosen skills regarding upper extremity in persons with tetraplegia and (2) to illustrate how to apply it into clinical practice and how to objectify it. A task-oriented client-centered upper extremity skilled training module (ToCUEST) has been developed with the aim of focusing the training on skills or activities the patient is really interested in. This improves patient's motivation and enlarges the probability that the patient continues to use these skills after having finished the training, which, in turn, may improve the ultimate rehabilitation outcome, that is, participation in the community.

To guarantee that the training is focused on specific skills incorporating patient's preferences, the client-centered component and the task-oriented component were explicitly presented and further elaborated in the present concept.

ToCUEST may induce a number of changes in the rehabilitation program of C-SCI. First, the emphasis may be more on the ICF activity level, both in training and in evaluation, because rehabilitation goals emerge from the patient's own needs. Second, rehabilitation programs may be condensed and inpatient stay may shorten, because specific goals rather than an extensive package of rehabilitation goals are targeted. Third, because SCI is a chronic illness and personal goals may change over time, the modularity of the ToCUEST training enables persons who have been discharged and who encounter new needs in their daily life to train on these changing needs. Fourth, the training concept may stimulate interdisciplinary teamwork in that the

Table 6 Training program of TS

<i>Training principle</i>		
Part practice	2 subtasks	Cutting food/using both knife and fork
Whole practice	Combine	Cutting food and using both utensils
Random practice		Altering the order of different training aspects
Distribution-based practice		Spread sessions over the day
<i>Subtask: cutting food</i>		
Muscle strength training		
initial maximal performance	3 sets of 10	Cutting soft cake
Progression	3 sets of 10	Cutting more dense products
Variability		Different kinds of products
Overlearning		She continued practising even after having reached the 0 GAS score
<i>Subtask: using both utensils</i>		
Stages of motor learning	Cognitive	Much guidance and feedback on how to perform the task
	Associative	Feedback and guidance reduced, as she knew which strategy to use
	Autonomous	Eating task with many variations, without verbal feedback and adding dual tasks like talking or counting simultaneous
Adaptive equipment	Initial	She first learned to handle adapted utensils
	Progression	Handle normal knife and fork
<i>Training parameters</i>		
Training frequency		3 × /week; 90'/day
Duration		Module of 8 weeks

Abbreviation: GAS, Goal Attainment Scale.

Table 7 Evaluation of TS's training program

<i>Measures</i>	<i>Before</i>	<i>After</i>	
GAS	−2	+1,3	After the training, Mrs TS was able to eat using an adapted knife and fork and was able to cut a steak (+1); She was able to style her hair independently (+2) and to put up her make-up except for the eyeliner (+1).
COPM performance	3	7	She rated her performance of the eating task as 'rather well' and she was satisfied about her performance of this task.
COPM satisfaction	4	8	
VLT	35	40	To measure a generalized effect of the training, the occupational therapist assessed Mrs TS's performance using the VLT, the QIF and the FIM on which she progressed 5, 3 and 6 points respectively. She did not only demonstrate improvement on the chosen skills, but also on other skills like e.g. toilet use, washing and dressing, indicating that a generalization effect may have been present.
QIF	16	19	
FIMmot	66	72	

Abbreviations: COPM, Canadian Occupational Performance Measure; FIM, Functional Independence Measure; QIF, Quadriplegia Index of Function; VLT, Van Lieshout Test.

traditionally boundaries between the domains of physiotherapists and occupational therapists will fade. Literature used to mainly focus on one single discipline. For example, Jacobs and Nash¹⁶ refer to physical therapy, while Popovic *et al.*²⁰ mainly focus on occupational therapy. In the present concept, the strength of each discipline is applied in a combined effort. This may improve intervention quality and may stimulate therapists' creativity, in which therapists act as a coach rather than a hands-on therapist.

Both the ICF and the training concept focus on holistic human functioning, including the effects of environmental or external factors and enhance interdisciplinary rehabilitation with the ultimate goal of improving the level of participation. By linking the present training concept to the ICF, training particular skills may be part of a broader rehabilitation program in which the ICF is used as a

common language in rehabilitation management. This may be reinforced using the specific ICF core set for SCI. As the focus of the ToCUEST program is on the patient's individual needs that he encounters in daily life, it is assumed that ToCUEST has an impact on the level of participation.

The present paper explains the different elements of the ToCUEST module and how to apply into practice. In Spooren *et al.*²¹ the ToCUEST module will be evaluated with regard to the added value of combining the client-centered and task-oriented components into a training program to improve upper extremity skilled performance in persons with C-SCI.

Conflict of interest

The authors declare no conflict of interest.

Acknowledgements

We thank E Rameckers (PT, PhD), A Timmermans (PT, PhD), V Schroyen (PT, MSc) and D Wade (MD, Prof, PhD) for the constructive discussion and critical notes.

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