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Research Article

Research on Predicting the Status of Returning to Work for Injured Workers Based on the ICF Upper Limb Vocational Ability Assessment System

Feng Lanfang[*] [ID], **Liu Xiaomin** [ID], **Lu Xunwen** [ID]

Occupational Rehabilitation Department, Guangdong Work Injury Rehabilitation Center, Guangzhou, China

Abstract

Objective: To verify the accuracy and effectiveness of the ICF Upper Limb Vocational Ability Assessment System (ULVAAS) in assessing the occupational capacity of patients with upper extremity injuries. *Methods*: The ICF-ULVAAS tool was applied to assess the work ability of 119 patients and suggestions for returning to work were given. After discharge, their work status was determined through telephone follow-up for 3 months. The evaluated resumption of work suggestions were compared and analyzed with their actual resumption of work status, in order to verify the predictive accuracy of the ULVAAS. *Results*: The K coefficient of consistency between the predicted return to work suggestion based on the assessment of upper limb occupational ability and the actual work status of the patient after discharge was 0.322 (p<0.001), with an overall accuracy of 85.71%. The consistency between the therapist's advice on resuming work and the patient's actual resumption of work status is not significantly correlated with their educational background and occupational nature. *Conclusion*: The ULVAAS based on the ICF can effectively assess the vocational ability of patients with hand and upper extremity injuries, and provide appropriate recommendations for returning to work based on the assessment results.

Keywords

ICF, Vocational Ability Assessment, Vocational Rehabilitation, Return to Work

1. Introduction

The International Classification of Functioning, Disability and Health (ICF) is a theoretical framework and classification system for describing health and related conditions, officially promulgated by the World Health Organization (WHO) in 2001 at the World Health Assembly [1]. It constructs a theoretical framework and classification system from the perspective of the impact of diseases, disabilities, and other health conditions on body structure and function, activity capacity, and participation capacity; taking functional impairment as a starting point, it integrates biological, psychological, social, and environmental aspects, which is more in line with the core goals of modern rehabilitation medicine for improving and restoring function, and has positive significance for strengthening the construction of the discipline of rehabilitation medicine and improving rehabilitation services [2]. Many experts and scholars internationally have constructed multidisciplinary assessment systems based on the ICF for various diseases [3, 4]. The research group has con-

structed a vocational ability assessment tool for upper limb injury patients based on the ICF core combination of vocational rehabilitation [5], which evaluates the functional status of upper limb injury patients from three dimensions: physical structure and function, individual activity, and social participation. The purpose of this study is to validate the effectiveness of the ULVAAS tool based on the ICF in predicting the return-to-work status of upper limb injury patients.

2. Methods

2.1. General Information

The research subjects are patients with hand and upper limb injuries who participated in occupational rehabilitation at Guangdong Provincial Work Injury Rehabilitation Hospital from January 2022 to December 2023. Inclusion criteria: 1) Patients clinically diagnosed with upper limb injuries below the shoulder joint; 2) The patient is informed and agrees to undergo functional assessment; 3) Willing to participate in the study and agree to a telephone follow-up after 3 months; 4) Age between 18 and 59 years old. Exclusion criteria: 1) Cognitive function impairment; 2) Patients who do not meet the age requirements or have no intention of employment. A total of 119 cases were selected according to these criteria, with an average age of 41.18 ± 9.907 years. Among them, there were 93 males and 26 females. There were 36 cases of shoulder joint injury, 32 cases of elbow joint injury, and 51 cases of forearm and hand injury.

2.2. Methods

Hand and upper limb patients who were admitted to the Occupational Rehabilitation Department of Guangdong Pro-

vincial Work Injury Rehabilitation Hospital between January 2022 and December 2023 will be evaluated for their work ability using the ICF ULVAAS tool before discharge. Based on the evaluation results and the patient's job requirements before injury, they will be paired and given corresponding suggestions for returning to work (returning to their original job position, adjusting work tasks, different job positions in the original company, re-employment or re-training, and not suitable for returning to work). Three months after the patient's discharge, a telephone follow-up was conducted to assess their actual resumption of work. Statistical analysis was conducted between the suggestions for resumption of work before discharge and the actual resumption of work, in order to test the effectiveness of the upper limb occupational ability assessment tool. The data was statistically analyzed using SPSS 25.0 software.

2.3. Assessment Indicators

Upper Limb Vocational Ability Assessment (ULVAAS): The ULVAAS tool developed by the research group based on the ICF vocational rehabilitation combination was used [5]. It is an ICF upper limb vocational ability assessment system based on the ICF vocational rehabilitation combination, including four primary indicators and 41 secondary indicators: body structure and physical function, activity and participation, environmental factors. It combines job demand analysis to assess the vocational ability of upper limb injury patients, including upper limb activity, flexibility, strength, sensation, physical handling ability, hand operation ability, etc., to more effectively and comprehensively understand the basic work ability and vocational ability matching degree of upper limb disability patients (see Table 1).

Table 1. The Upper Limb Vocational Ability Assessment System (ULVAAS).

ICF classification		evaluation content and results	
Body structure	Body structure (s720, s730) The bones, muscles, joints, etc. of the upper limbs	Body structure (s720, s730) The bones, muscles, joints, etc. of the upper limbs	
		ROM:	
		MMT:	
Physical function	(b280, b455, b730, b740, b810, etc.) Activity, sensation, strength, flexibility	Grip strength	L/R:_____/_____kg
		Pinching force	(Side Pinching) L/R:_____/_____kg (Three Finger Pinch) L/R:_____/_____kg
		Flexibility	Purdue pegboard test: Right hand test: left hand test: two hand test: assembly test:

ICF classification		evaluation content and results	
		Feeling	Monofilament tactile sensation
		Lifting with both hands, back and forth 5 times from the ground to the waist (squatting/bending)	_____/_____kg
		Lift with both hands, back and forth 5 times from waist to shoulder level	_____kg
		Lift with both hands, back and forth 5 times at waist height	_____kg
		Left/Right/Hands Lift, Moving Forward 6 * 2 m	_____kg
		Push/pull weight: 3 meters	Push:_____kg Pull:_____kg
		Isometric push/pull force	Push:_____kg Pull:_____kg
		Description of tool usage (including tool types, usage, etc.)	
Activities and Participation	(d440, d445, d825, d840, d845, d850, etc.) Tool usage, employment intention, social psychology, etc	Employment willingness assessment	pre-contemplation, contemplation, pre-oaration, ation
		Social psychological assessment	reference psychological assessment
		Work behavior assessment	
		Active force consistency assessment	CV: L/R _____/_____
		employment relationship	Good, average, and poor
Environmental factors	Employment relationship, employment guidance, and job placement coordination (e430, e550, e590, etc.)	Is employment guidance necessary	Yes No
		Is work placement coordination necessary	Yes No

Return-to-work recommendations: Based on the assessment of the upper limb vocational ability assessment system, the therapist combines work analysis, simulation evaluation, and other results to conduct work matching. Based on the patient's matching situation, the therapist provides effective resumption of work suggestions that are suitable for the patient's actual situation, This includes five outcomes: 1) returning to the original job position, 2) adjusting some work tasks in the original job position, 3) different positions in the original company, 4) re employment or entrepreneurship, and 5) not suggesting resumption of work [13]. To reduce errors, all participating therapists have received unified training and are occupational rehabilitation therapists who have worked for more than 5 years.

Employment follow-up results: Three months after the patient's discharge, the employment counselor will conduct telephone follow-up on the patient according to the set form to understand their current resumption of work status. Compare the employment status of patients based on five resumption outcomes: 1) returning to their original job position, 2) adjusting some work tasks in their original job position, 3) different positions in the original company, 4) re employment or entrepreneurship, 5) not resuming work or retiring, and record the patient's resumption outcome. Telephone follow-up usually takes about 10 minutes.

2.4. Statistical Methods

Descriptive statistics will be used to describe the demographic characteristics of patients, and quantitative data will be represented by ($\bar{x} \pm s$); The comparison between two groups of categorical data is conducted using chi square test. When the theoretical frequency in the test is less than 5 or the X2 test result is close to 0.05, Fisher's exact probability method is used, and bilateral $P<0.05$ indicates significant difference. Simultaneously calculate the correct prediction rate for returning to work recommendations. All statistical analyses will be conducted using SPSS 25.0 software, with a significance

level set at P<0.01.

3. Results

3.1. General Demographic Statistics

Table 2. Statistical description of patient demographic data (n=119).

Title		Number	Proportion percentage	$\bar{x}\pm s$
Age (year)				41.18±9.907
gender	man	93	78.2%	
	woman	26	21.8%	
education	Primary school	24	20.2%	
	middle school	39	32.8%	
	high school	41	34.4%	
	College degree	15	12.6%	
	administration	7	5.8%	
	Equipment operators	60	50.4%	
Occupational nature	Clerks	4	3.3%	
	service staff	36	30.3%	
	Professional and technical personnel	12	10.2%	
Time to resume work after discharge (days)				28.16±53.599

From January 2022 to December 2023, a total of 120 cases of relevant data were collected in this study, and 1 person was lost to follow-up. The remaining 119 cases completed the telephone follow-up after 3 months of discharge. The average age of the included 119 patients was 41.18±9.907 years, and the average number of days to return to work after discharge was 28.16±53.599 days. The general demographic data of the study subjects are shown in Table 2.

3.2. Patient Return-to-Work Related Data

In this study, a total of 108 patients successfully returned to work, accounting for 90.7%. Among them, 58 cases returned

to the original job, 25 cases returned to the original job but with some job tasks adjusted, 16 cases returned to different job positions in the original company, 9 cases were re-employed or started their own businesses, and 11 patients did not return to work or retired due to reasons such as retirement or mismatch of function. Combining the pre-discharge return-to-work recommendations, the actual return-to-work positions of 102 patients were consistent with the return-to-work recommendations given by the therapists, with an accuracy rate of 85.71%. See Table 3 for details.

Table 3 Comparison of pre-discharge return-to-work recommendations and post-discharge return-to-work status of patients (n=119).

Table 3. Comparison of patients' suggestions for resuming work before discharge and their status of resuming work after discharge (n=119).

		Suggestions for resuming work before discharge	Consistent with the suggestion to resume work	Accuracy (%)
Resumed work	Original job position	65	58	89.23

		Suggestions for resuming work before discharge	Consistent with the suggestion to resume work	Accuracy (%)
	Original job adjustment tasks	26	25	96.15
	Different positions in the original company	23	16	69.56
	Reemployment or entrepreneurship	3	9	33.33
Not resuming work	Not recommended to resume work or retire	2	11	18.18
		yes	102	85.71
Same as the suggestion to resume work before discharge		no	17	14.29

The comparison of return-to-work status among different education levels and occupational nature is shown in Table 4. There was no significant difference in the consistency between the actual return-to-work status of the patients and the return-to-work recommendations given by the therapists in terms of education level and occupational nature, suggesting that the therapist's assessment of the patient's work ability was not affected by the patient's occupational nature or educational level.

Table 4. *Comparison of return-to-work status among patients with different education levels and occupational nature (n=119).*

Title		number	Consistent with the suggestion to resume work	Accuracy (%)
	Primary school	24	20	83.33
education	middle school	39	32	82.05
	high school	41	37	90.24
	College degree	15	13	86.66
	administration	7	5	71.43
	Equipment operators	60	54	90
Occupational nature	Clerks	4	3	75
	service staff	36	30	83.33
	Professional and technical personnel	12	10	83.33

4. Discussion

The results of this study found that the accuracy of predicting the same return to work status as the patient after discharge based on the evaluation results given by the therapist before discharge was 85.71%, and the accuracy of the suggestion to return to the original position (89.23% of the original position or 96.15% of the original position to adjust work tasks) was higher than that of 69.56% for different positions and 33.33% for re starting a business. We consider that patients participating in occupational rehabilitation retain most of their hand functions, most of their work abilities can adapt to the original position, and the acceptance of the original position by patients and the company is higher. Moreover, there are too many uncertain factors for different positions or re employment, and the probability of changes occurring in the later stage is relatively high, so the accuracy of prediction is relatively low. However, therapists still need to provide appropriate recommendations for returning to work based on the patient's objective evaluation results and the actual situation of the job position.

Hand and upper limb injuries account for approximately 6.6% -28.6% of all external injuries, making them a highly common type of injury [6]. More likely to occur in the workplace, followed by family and traffic accidents, with the majority of injured individuals being young adults engaged in

manual labor [7]. More than 90% of various activities in daily life and work are achieved through hands [8]. Hand injuries do not endanger life, but can lead to lifelong disability, loss of labor and living abilities, and seriously affect the basic survival of individuals; At the same time, due to the fact that hand injuries mainly occur in young and middle-aged men aged 20-40 [9], which often involve family poverty caused by injuries and poverty return due to injuries, the functional reconstruction and rehabilitation of hand injuries are very important aspects of modern medical research [10]. Meanwhile, promoting the return of a hand injury worker to work is a challenge for both doctors and employers [11].

Vocational competency assessment is the first stop of vocational rehabilitation services, through which the basic work ability, development potential level, and vocational competency matching degree of disabled persons can be obtained [12]. Presently, there is no practical occupational capacity assessment system in China, especially a lack of matching tools that can target the characteristics of workers and work for upper limb disabled patients. Only foreign assessment tools and databases can be borrowed. However, due to cultural differences and differences in reference standards both domestically and internationally, foreign tools and databases are not entirely applicable to China. The ICF vocational rehabilitation core combination is a frame of reference for describing working ability [14]. It is important to construct a functional testing system related to work that follows the biological psychological social framework. Such a database will contribute to vocational rehabilitation professional staff choose appropriate testing methods when evaluating work-related ability and providing recommended interventions.

In the 2021 ICF expert consensus, it was pointed out that the ICF itself, core combinations, rehabilitation combinations, and other versions are all "category lists" rather than evaluation scales. When evaluating the health status of patients, it is necessary to explain and quantify the evaluation content, evaluation methods, evaluation standards, functional level, and other aspects of each category of ICF [15]. This study applies the ICF occupational rehabilitation core combination as the research framework to construct a work-related upper limb function testing system that follows the biological psychological social framework. The operational items and testing standards of the ICF category are then specified for use, solving the problem of "how to operate" in the ICF category [16]. Based on the analysis results of the ULVAAS, vocational rehabilitation professionals can improve the hand work ability and productivity that patients lack in a targeted manner, thereby assisting them in returning to work and reducing social costs.

5. Conclusion

In summary, the ICF based upper limb occupational ability assessment system can effectively assess the work ability of patients with hand and upper extremity injuries, and provide appropriate return to work recommendations based on the evaluation results. The results of this study are of great significance for evaluating whether patients with upper limb injuries can safely return to work. And the research method can be extended to occupational injury diseases such as limb fractures, brain injuries, burns, spinal cord injuries, etc., to evaluate the occupational labor ability of disabled workers and assist more disabled patients in returning to work.

Abbreviations

ULVAAS	Upper Limb Vocational Ability Assessment
ICF	International Classification of Functioning, Disability and Health
WHO	World Health Organization

Ethics Approval

Ethical issues are not involved in this paper.

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Author Contributions

Feng Lanfan: Conceptualization, Data curation, Formal Analysis, Funding acquisition, Supervision, Writing – original draft, Writing – review & editing

Liu Xiaomin: Data curation, Formal Analysis, Funding acquisition, Investigation

Lu Xunwen: Methodology, Project administration, Resources, Software, Validation

Conflicts of Interest

None declared.

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