Validation of the Disabilities of the Arm, Shoulder and Hand (DASH) Score Compared to the Neck Disability Index (NDI) in Patients Undergoing Cervical Spine Surgery

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Introduction

The Disabilities of the Arm, Shoulder and Hand (DASH) score is a self-reported outcome measure of upper extremity disability that is increasingly used in patients with neck pain and/or upper extremity disorders. In this retrospective concurrent validity study, we examine the validity and agreement of the DASH score compared to the commonly used neck-specific Neck Disability Index (NDI) and Visual Analogue Scale (VAS) for Pain in patients undergoing cervical spine surgery.

Methods

We retrospectively analyzed 432 patients undergoing cervical decompression and fusion surgery at our institution from 2013 to 2016 (Table 1). DASH, NDI, and VAS scores were collected for each patient before undergoing surgery, and at subsequent follow-up appointments. We calculated Pearson's correlation coefficients between the self-reported outcome measures using preoperative, mean postoperative, and improvement scores. Overall analysis including all patients was performed, and subgroup analysis for patients with predominant radiculopathy or myelopathy symptoms. Bland-Altman analysis was used to evaluate for agreement between the DASH and NDI scores.
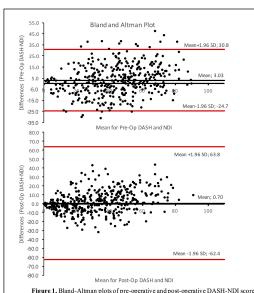
Results

Overall analysis showed positive correlations between DASH and NDI pre-operatively and post-operatively (r=0.77 and r=0.41 respectively, p<0.001; Table 2), and between DASH and VAS (r=0.33 pre-operatively and r=0.43 post-operatively, p<0.001). Subgroup analysis in radiculopathy and myelopathy patients demonstrated similar concordance (Tables 3 and 4): Radiculopathy DASH vs. NDI (r=0.8, p<0.001 preoperatively and r=0.23, p<0.01 post-operatively) and Myelopathy DASH vs. NDI (r=0.76, p<0.001 preoperatively and r=0.82, p<0.01 post-operatively). Bland-Altman plots showed agreement between the DASH and NDI (Figure 1). Mean DASH scores were higher by 0.7% to 3.03% compared to the NDI.

Conclusions

Neck pain and upper extremity disability evaluations using the DASH questionnaire were shown to have moderate to high correlations with scores from the neck-specific NDI and VAS for pain. Our results highlight the feasibility of using DASH to track quality-of-life and functional improvement after cervical spine surgery.

Table 1. Patient Characteristics, Demographics, and Scores on Self-Reported Outcome Measures

Variable	N (%); Total N=432	Mean	Standard Deviation
Age (years)		57.4	11.1
Gender (n=432)			
Male	235 (54.4)		
Female	197 (45.6)		
BMI (kg.m2)		29.96	5.9
Procedure (n=432)			
ACDF	336 (77.8)		
PCDF	62 (14.4)		
Other	33 (7.8)		
Clinical Indications (n=432)			
Myelopathy	259 (60)		
Radiculopathy	173 (40)		
Symptom Duration (n=432)			
<6 months	167 (38.7)		
>6 months	265 (61.3)		
Average duration of follow-up (days)		188	134
Self-Reported Outcomes			
Pre-Op NDI (/50)	406	21.5	9.5
Pre-Op DASH (/100)	388	45.8	22.2
Pre-Op VAS (/10)	110	5.6	2.5
Post-Op NDI (/50)	426	16	17
Post-Op DASH (/100)	417	33.1	22.5
Post-Op VAS (/10)	61	3.4	2.4
NDI Improvement Score (/50)	401	-5.2	17.3
DASH Improvement Score (/100)	378	-12.9	21
VAS Improvement Score (/10)	45	-2.44	2.95

Figure 1. Bland-Altman plots of pre-operative and post-operative DASH-NDI score differences vs. the average of NDI and DASH scores for each patient. The plots show the agreement between the NDI and DASH in evaluating functional and pain-related self-reported outcomes in patients undergoing cervical spine surgery. Red lines represent the upper and lower limits of agreement.

Table 2. Overall Analysis (N=432)

	Pre-Op VAS Score	Pre-Op NDI Score	Pre-Op DASH Score
Pre-Op VAS Score	1		
Pre-Op NDI Score	0.60 (n=108)	1	
Pre-Op DASH Score	0.33 (n=97)	0.77 (n=385)	1

	Post-Op VAS Score	Post-Op NDI Score	Post-Op DASH Score
Post-Op VAS Score	1		
Post-Op NDI Score	0.61 (n=61)	1	
Post-Op DASH Score	0.43 (n=59)	0.41 (n=415)	1

	NDI Improvement Score	DASH Improvement Score	VAS Improvement Score
NDI Improvement Score	1		
DASH Improvement Score	0.38 (n=374)	1	
VAS Improvement Score	0.52 (n=43)	0.53 (n=40)	1

Table 3. Radiculopathy Analysis (n=173)

	Pre-Op VAS Score	Pre-Op NDI Score	Pre-Op DASH Score
Pre-Op VAS Score	1		
Pre-Op NDI Score	0.65 (n=34)	1	
Pre-Op DASH Score	0.55 (n=30) [p<0.01]	0.8 (n=155)	1

	Post-Op VAS Score	Post-Op NDI Score	Post-Op DASH Score
Post-Op VAS Score	1		
Post-Op NDI Score	0.47 (n=25) [p<0.05]	1	
Post-Op DASH Score	0.57 (n=25) [p<0.01]	0.23 (n=166) [p<0.01]	1

	NDI Improvement Score	DASH Improvement Score	VAS Improvement Score
NDI Improvement Score	1		
DASH Improvement Score	0.29 (n=151)	1	
VAS Improvement Score	0.26 (n=14) [p=0.37]	0.24 (n=13) [p=0.42]	1

Table 4. Myelopathy Analysis (n=259)

	Pre-Op VAS Score	Pre-Op NDI Score	Pre-Op DASH Score
Pre-Op VAS Score	1		
Pre-Op NDI Score	0.58 (n=74)	1	
Pre-Op DASH Score	0.26 (n=67) [p<0.05]	0.76 (n=230)	1

	Post-Op VAS Score	Post-Op NDI Score	Post-Op DASH Score
Post-Op VAS Score	1		
Post-Op NDI Score	0.74 (n=36)	1	
Post-Op DASH Score	0.50 (n=34) [p<0.01]	0.82 (n=249)	1

	NDI Improvement Score	DASH Improvement Score	VAS Improvement Score
NDI Improvement Score	1		
DASH Improvement Score	0.75 (n=223)	1	
VAS Improvement Score	0.64 (n=29)	0.66 (n=27)	1

Table 2. Correlation arrays for patient scores on the various self-reported outcome measures (NDI, DASH, VAS) pre-operatively and post-operatively. **Tables 3.** and **4.** represent the subgroup analysis for patients with predominantly radiculopathy and myelopathy symptoms respectively, as determined by radiographic and clinical information. Measure of correlation is the Pearson correlation coefficient (r). All values bolded are significant at **p<0.001**, unless otherwise indicated. Number of observations (n) varies per comparison, according to available completed questionnaires.