Measurement and evaluation of hip fracture care

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Validation of the Fracture Mobility Score against the Parker Mobility Score in hip fracture patients

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Abstract

Background

The Parker Mobility Score has proven to be a valid and reliable measurement of hip fracture patient mobility. For hip fracture registries the Fracture Mobility Score is advised and used, although this score has never been validated. This study aims to validate the Fracture Mobility Score against the Parker Mobility Score.

Methods

The Dutch Hip Fracture Audit uses the Fracture Mobility Score (categorical scale). For the purpose of this study, five hospitals registered both the Fracture Mobility Score and the Parker Mobility Score (0 – 9 scale) for every admitted hip fracture patient in 2018. The Spearman correlation between the two scores was calculated. To test whether the correlation coefficient remained stable among different patient subgroups, analyses were stratified according to baseline patient characteristics.

Results

In total 1,201 hip fracture patients were included. The Spearman correlation between the Fracture Mobility Score and the Parker Mobility Score was strong: 0.73 ($p = < 0.001$). Stratified for gender, age, ASA grade, dementia, KATZ Index of Independence in Activities of Daily Living (KATZ-6 ADL score), living situation and nutritional status, the correlation coefficient varied between 0.40 and 0.84. For patients aged 90 and over, having ASA grade 3 or 4, suffering from dementia, having a KATZ-6 ADL score of 1 – 6, living in an institution and/or being malnourished, the correlation was moderate.

Conclusion

The Fracture Mobility Score is overall strongly correlated with the Parker Mobility Score and can be considered as a valid score to measure hip fracture patient mobility. This may encourage other hip fracture audits to also use the Fracture Mobility Score, which would increase the uniformity of mobility score results among national hip fracture audits and decrease the overall registration load.

Introduction

To improve the quality of care for patients with a hip fracture, the nationwide Dutch Hip Fracture Audit (DHFA) was established in the Netherlands in 2016 [1]. Prospective collection of data on patient characteristics, logistic hip fracture processes and outcome parameters is an important part of this audit [1]. At the time the DHFA was developed, hip fracture audits were already up and running in several other countries. The results of these audits have shown to improve the quality of care for hip fracture patients [2-11]. The level of pre-fracture mobility has proven to be an important predictor for 30-day mortality in frail hip fracture patients [12,13]. In addition, a mobility score can be used to monitor the postoperative recovery process, and the return to pre-fracture mobility is used as a quality indicator [14].

The mobility score that the Fragility Fracture Network (FFN) decided to use for audits on care for hip fracture patients, is the Fracture Mobility Score [15]. In this score patient mobility is captured in a categorical scale consisting of five categories ranging from free mobility without any aids to no functional mobility (when using lower limbs). Based on the advice of the FFN and in line with other European hip fracture audits, the DHFA decided to use the Fracture Mobility Score. Although this score is used in the National Hip Fracture Database (UK minus Scotland), the Scottish Hip Fracture Audit and the Alters Trauma Register DGU (Germany), and is recommended by the FFN, it has never been validated to our knowledge [15-18].

Another score to measure mobility of hip fracture patients is the Parker Mobility Score. Studies have shown that the Parker Mobility Score, also known as the New Mobility Score, is a valid predictor for in-hospital rehabilitation potential, 6-month functional outcome and 1-year mortality with a high inter-test reliability with respect to measurement of hip fracture patient mobility [19-21]. The Parker Mobility Score is a composite measurement of the patient's mobility indoors, outdoors and during shopping, and is used in studies either to measure the mobility as an outcome measure, or as a predictor for mortality [12,19,21-24]. This study aims to validate the Fracture Mobility Score against the Parker Mobility Score in hip fracture patients.

Methods

Mobility scores

The Fracture Mobility Score (Figure 1) classifies the patient's mobility in one of the following five categories: freely mobile without aids, mobile outdoors with one aid, mobile outdoors with two aids or frame, some indoor mobility but never going outside without help, and no functional mobility (when using lower limbs).

To determine the Parker Mobility Score (Figure 1), patient mobility is assessed in three different situations (able to get about the house, able to get out of the house and able to go shopping) on a four-point scale: no difficulty (3 points), with an aid (2 points), with help from another person (1 point) or not at all (0 points). The highest overall score of 9 indicates the best possible mobility.

Figure 1. Fracture Mobility Score and Parker Mobility Score

Fracture Mobility Score
Score is one of the following categories

- ❐ Freely mobile without aids
- ❐ Mobile outdoors with one aid
- ❐ Mobile outdoors with two aids or frame
- ❐ Some indoor mobility but never going outside without help
- ❐ No functional mobility (when using lower limbs)
- ❐ Unknown*

Parker Mobility Score
Score 0 - 9

Able to get about the house	❐ No difficulty (3 points)	❐ With an aid (2 points)
	❐ With help from another person (1 point)	❐ Not at all (0 points)
Able to get out of the house	❐ No difficulty (3 points)	❐ With an aid (2 points)
	❐ With help from another person (1 point)	❐ Not at all (0 points)
Able to go shopping	❐ No difficulty (3 points)	❐ With an aid (2 points)
	❐ With help from another person (1 point)	❐ Not at all (0 points)

* Variable added to the DHFA data dictionary

Data collection

As part of the DHFA, the Fracture Mobility Score has to be collected for every patient at admission, at hospital discharge and three months after surgery [1]. For registry purposes, the category 'unknown' was added to the five original categories of the Fracture Mobility Score. Five Dutch hospitals were asked to register, next to the Fracture Mobility Score, the Parker Mobility Score throughout 2018 for all patients of 70 years and older at admission. Non-operated patients were excluded from the analysis.

Analysis

Baseline patient characteristics were described as mean with standard deviation for normally distributed continuous variables, as median with interquartile range for non-normally distributed continuous variables and as number and percentage for categorical variables.

The baseline characteristics of the group of patients in which the Parker Mobility Score was missing were compared to those in which the Parker Mobility score was not missing. To test differences between these two groups, the independent sample T-test was used for continuous normally distributed variables, the Mann-Whitney U test for non-normally distributed variables and the Chi-square test for categorical variables. The group of patients in which the Parker Mobility Score was not scored, was excluded from further analysis. Patients scored as 'unknown' on the Fracture Mobility Score were considered to be missing.

The primary outcome was the correlation between the Fracture Mobility Score and the Parker Mobility Score. A scatter plot was constructed to visualize the relation between the two mobility scores. The Spearman correlation was calculated since the Parker Mobility Score data were not normally distributed. To interpret the magnitude of the correlation, the cut-off points as described in literature were used [25]. The secondary outcome was that the Spearman correlation remained the same when the study cohort was stratified by baseline patient characteristics. If a variable had < 5% of missing data, the missing data was excluded from further analyses. The data was analyzed using IBM SPSS Statistics® version 22. A $p < 0.05$ was regarded as statistically significant.

Results

Baseline patient characteristics

In total 1,648 patients were registered, of whom 277 were younger than 70 years or had not been operated on. In 170 patients, the variable Parker Mobility Score was missing. These 170 patients had more often dementia (42% versus 20%, $p = < 0.001$), had higher KATZ-6 ADL scores (median 3 versus 1, $p = < 0.001$), lived more often institutionalized (46% versus 28%, $p = < 0.001$) and were more often malnourished (29% versus 22%, $p = < 0.001$). After exclusion of patients younger than 70 years, non-operated patients and patients in which the Parker Mobility Score was not scored, 1,201 patients were analyzed. The baseline patient characteristics are shown in Table 1.

Table 1. Baseline patient characteristics

		Total (n = 1,201)	
Gender			
	Female	818	(68.1%)
	Male	383	(31.9%)
Age			
	Mean age: 83.9 years (IQR: 79 – 89)		
	70 – 79 years	329	(27.4%)
	80 – 89 years	591	(49.2%)
	90 years and over	281	(23.4%)

ASA grade			
	1 – 2	423	35.2%
	3 – 4	740	61.6%
	Missing	38	3.2%
Dementia			
	No	924	(76.9%)
	Yes	242	(20.1%)
	Missing	35	(2.9%)
KATZ-6 ADL score			
	Median: 1 (IQR: 0 – 4)		
	0	560	(46.6%)
	1 – 3	277	(23.1%)
	4 – 6	318	(26.5%)
	Missing	46	(3.8%)
Pre-fracture living situation			
	Independent, with or without home care services	865	(72.0%)
	Institutionalized	334	(27.8%)
	Missing	2	(0.2%)
Nutritional status			
	No increased risk of malnutrition (SNAQ 0 or MUST 0)	895	(74.5%)
	Slightly increased risk of malnutrition (SNAQ 1-2 or MUST 1)	143	(11.9%)
	Increased risk of malnutrition (SNAQ ≥ 3 or MUST ≥2)	115	(9.6%)
	Missing	48	(3.9%)
Parker Mobility Score			
	Median: 6 (IQR: 4 - 9)		
Fracture mobility Score			
	Freely mobile without aids	456	(38.0%)
	Mobile outdoors with one aid	45	(3.7%)
	Mobile outdoors with two aids or frame	482	(40.1%)
	Some indoor mobility but never going outside without help	153	(12.7%)
	No functional mobility (when using lower limbs)	27	(2.7%)
	Unknown	38	(3.2%)

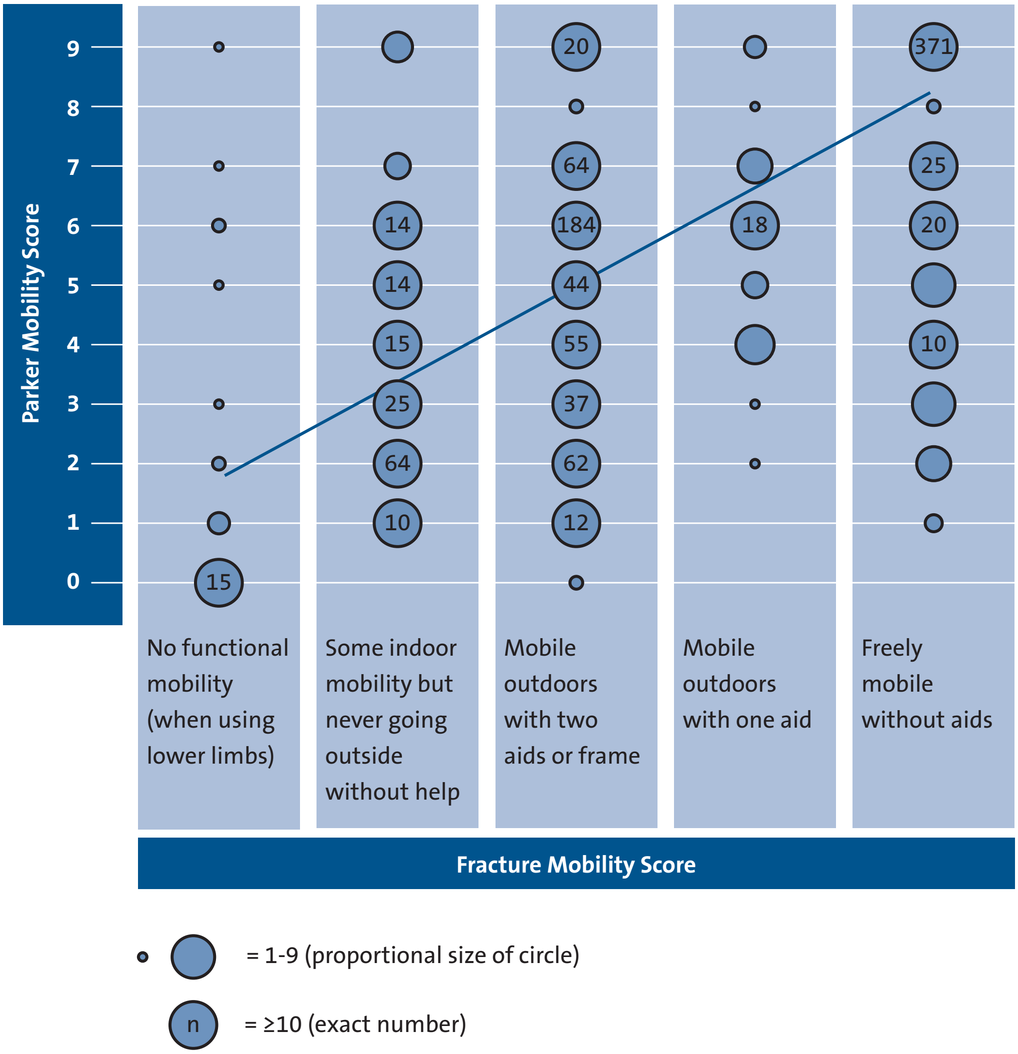
Data is presented as number (with corresponding percentage between brackets), unless stated otherwise.

ASA	American Society of Anesthesiologists physical status classification system
KATZ-6 ADL	KATZ Index of Independence in Activities of Daily Living
SNAQ	Short Nutritional Assessment Questionnaire
MUST	Malnutrition Universal Screening Tool
IQR	Interquartile range

Correlation

The Spearman correlation between the Fracture Mobility Score and the Parker Mobility Score was 0.73 (95% confidence interval: 0.696 – 0.773, p = < 0.001). A correlation of 0.73 is considered as a strong correlation. The scatter plot showed a linear relationship between the two scores (Figure 2).

Figure 2. Scatter plot of Fracture Mobility Score and Parker Mobility Score, with linear fitted regression line



Correlation stratified on baseline patient characteristics

When stratified for gender, age, American Society of Anesthesiologists physical status classification system (ASA grade), KATZ Index of Independence in Activities of Daily Living (KATZ-6 ADL score), living situation and nutritional status, the Spearman correlation between the Fracture Mobility Score and the Parker Mobility Score varied between 0.45 and

0.84. A moderate correlation, defined as a correlation between 0.40 and 0.69, was found in patients aged 90 and over, having ASA grade 3 or 4, suffering from dementia, having a KATZ-6 ADL score of 1 – 6, living in an institution and/or being malnourished. For all other baseline characteristics, the correlation was strong (0.70 or higher), see Table 2.

Table 2. Stratified correlation coefficient of Fracture Mobility Score against Parker Mobility Score

		Total n = 1,201		Spearman correlation	*p*
Gender					
	Female	818	(68.1%)	0.71	< 0.001
	Male	383	(31.9%)	0.77	< 0.001
Age					
	70 – 79 years	329	(27.4%)	0.77	< 0.001
	80 – 89 years	591	(49.2%)	0.70	< 0.001
	90 years and over	281	(23.4%)	0.62	< 0.001
ASA grade					
	1 – 2	423	(35.2%)	0.78	< 0.001
	3 – 4	740	(61.6%)	0.67	< 0.001
Dementia					
	No	924	(76.9%)	0.76	< 0.001
	Yes	242	(20.1%)	0.45	< 0.001
KATZ-6 ADL score					
	0	560	(46.6%)	0.75	< 0.001
	1 – 3	277	(23.1%)	0.60	< 0.001
	4 – 6	318	(26.5%)	0.54	< 0.001
Pre-fracture living situation					
	Independent, with or without home care services	865	(72.0%)	0.84	< 0.001
	Institutionalized	334	(27.8%)	0.50	< 0.001
Nutritional status					
	No increased risk of malnutrition (SNAQ 0 or MUST 0)	895	(74.5%)	0.76	< 0.001
	Slightly increased risk of malnutrition (SNAQ 1-2 or MUST 1)	143	(11.9%)	0.60	< 0.001
	Increased risk of malnutrition (SNAQ ≥3 or MUST ≥2)	115	(9.6%)	0.61	< 0.001

ASA American Society of Anesthesiologists physical status classification system
KATZ-6 ADL KATZ Index of Independence in Activities of Daily Living
SNAQ Short Nutritional Assessment Questionnaire
MUST Malnutrition Universal Screening Tool

Discussion

This study, which validated the Fracture Mobility Score against the Parker Mobility Score, showed that overall these two scores are strongly correlated with each other, although for frailer patients (aged 90 and over, having ASA grade 3 or 4, suffering from dementia, having a KATZ-6 ADL score of 1 – 6, living in an institution and/or being malnourished) the correlation is moderate. A possible explanation for the moderate correlation in the frail patient group might be that most frail patients suffer from cognitive impairments [26]. Unreliable answers might be the reason why the mobility score was more often missing and moderately correlated in the frail patient category. This problem plays a role in the data collection for both the Fracture Mobility Score and the Parker Mobility Score, making one tool not the preferred one over the other. The Fracture Mobility Score can now be considered as a valid score to measure hip fracture patient mobility.

Mobility scores used in hip fracture audits

In a comparative study of national hip fracture audits, Johansen et al. concluded that mobility scores used in national hip fracture audits differed too much and were therefore not suitable for a consistent international comparison of mobility scores [27]. The fact that the Fracture Mobility Score has not previously been validated might be the reason why audits use different mobility scores instead of the Fracture Mobility Score as advised by the FFN. The Irish Hip Fracture Database uses the Parker Mobility Score and the Danish Hip Fracture Audit uses the Cumulated Ambulation Score [28,29]. The Spanish National Hip Fracture Registry, the Australian and New-Zealand Hip Fracture Registry and the Rikshöft (Sweden) have opted to use a mobility score that is slightly modified from the Fracture Mobility Score [30-32]. Our results can help to substantiate a broader use of the Fracture Mobility Score and stimulate its use in all hip fracture audits. This would enhance uniformity among international hip fracture audits and enable the benchmarking of mobility scores between hip fracture audits.

Benefits of the Fracture Mobility Score from an audit perspective

In large clinical hip fracture audits, ongoing efforts are being made to maintain the registration load as low as possible [1]. In this respect, the Fracture Mobility Score seems to be a preferred tool over both the Parker Mobility Score and the Cumulated Ambulation Score. For the Fracture Mobility Score only one question has to be answered, against three questions for both the Parker Mobility Score and the Cumulated Ambulation Score [19,29]. This lower number of questions does not seem to significantly diminish the registration load per patient, but on a nationwide scale it would certainly help reduce the administrative burden caused by registration. In the Netherlands, all approximately 18,500 hip fracture patients need to be entered into the DHFA and their mobility needs to be scored on three occasions (at admission, at hospital discharge and three months after surgery). This results in a difference of 111,000 questions (55,500 for the Parker Mobility Score versus 166,500 for the Fracture

Mobility Score) to be answered [1]. In general, the lower the registration load, the higher the chance of data completeness. From this perspective, every simplification of a query will be helpful, provided the value and the reliability of the answers are not affected.

To fairly benchmark hospitals in an audit, results need to be corrected for patient characteristics in a case-mix model. In the case-mix model the Observed is divided by the Expected, with the Expected being the sum of patients' estimated probabilities on the outcome measure of interest [33]. Patient mobility can also be used as a case-mix factor in the case-mix model. In the National Hip Fracture Database (UK minus Scotland), the Fracture Mobility Score has already been used as a case-mix factor in predicting 30-day mortality [34]. However, as 43% of patients were missing on the Fracture Mobility Score variable, all four walking ability categories had to be taken together in the case-mix model [35].

In clinical audits quality indicators are used to benchmark hospitals [14]. Patient mobility as measured by the Fracture Mobility Score can serve as such a quality indicator. As mobility is monitored during the rehabilitation process, the scores per mobility category in different phases of the rehabilitation process can be compared between hospitals [14].

Limitations

This study has some shortcomings. Ideally both mobility scores are registered in the Electronic Health Record (*Elektronisch Patiëntendossier* – EPD) by two independent persons, separately from each other, upon arrival at the emergency department. Most likely the physicians at the emergency department did not register the mobility scores, but only described in general terms how mobile the patient was before the fracture. Afterwards a data manager, in most hospitals one single person, had to translate the physician's description into both mobility scores. It is therefore reasonable to assume that the same person calculated both scores at the same time and that the calculation was not performed by two persons independently of each other. As a result, the correlation coefficient might be an overestimation.

The group of patients in which the Parker Mobility Score was not scored, was excluded from this study, although this group of patients was frailer than the non-missing group. Excluding this group of patients might imply a selection bias. A possible explanation for this high number of patients missing on the Parker Mobility Score compared to the Fracture Mobility Score is that the Fracture Mobility Score is an obligatory mobility score for Dutch hospitals, while it may have been easier to collect one mobility score only in frail patients.

Conclusion

In this study, the Fracture Mobility Score showed a strong correlation with the Parker Mobility Score, of which the validity and reliability had already been proven. The Fracture Mobility Score is a simple tool to measure mobility of hip fracture patients and can be used for audit purposes. The findings of this article may encourage other hip fracture audits to also use the Fracture Mobility Score. This will increase the uniformity of mobility score results among national hip fracture audits and will help decrease the overall registration load.

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