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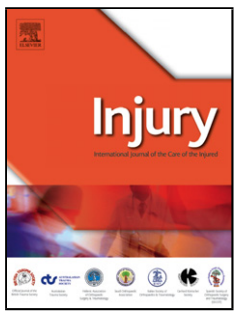

Title: A review of the revised Functional Capacity Index as a predictor of 12 month outcomes following injury

Author: <ce:author id="aut0005" author-id="S0020138317300062-e4db5ae2b86324c238457021d87e19d5"> Cameron S. Palmer<ce:author id="aut0010" author-id="S0020138317300062-5992616fc4eb098eb8cd6abaaea1f112"> Peter A. Cameron<ce:author id="aut0015" author-id="S0020138317300062-9e02a577b4fdfef91045228095d66421"> Belinda J. Gabbe

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A review of the revised Functional Capacity Index as a predictor of 12 month outcomes following injury

(Short Title: A review of the Functional Capacity Index)

Cameron S Palmer, GradDip (Clin Epi), BOrth (Hons), CAISS [1,2]

cameron.palmer@rch.org.au

Peter A Cameron, MBBS, MD, FACEM [1,3]

peter.cameron@monash.edu

Belinda J Gabbe, BPhysio(Hons), Grad Dip Biostats, MAppSc, PhD [1,4]

belinda.gabbe@monash.edu

1 Department of Epidemiology & Preventive Medicine, Monash University, Melbourne, Australia

2 Trauma Service, Royal Children's Hospital Melbourne, Parkville, Australia

3 Emergency Medicine, Hamad Medical Corporation, Doha, Qatar

4 Farr Institute - CIPHER, College of Medicine, Swansea University, Swansea, United Kingdom

Address for Correspondence:

Cameron S Palmer

The Royal Children's Hospital Melbourne

Flemington Rd, Parkville 3052 AUSTRALIA

Phone: +61 3 9345 4806

Fax: +61 3 9345 6668

Email: cameron.palmer@rch.org.au

Abstract

The measurement of functional outcomes following severe trauma has been widely recognised as a priority for countries with developed trauma systems. In this respect, the Functional Capacity Index (FCI), a multi-attribute index which has been incorporated into the most recent Abbreviated Injury Scale (AIS) dictionary, is potentially attractive as it offers 12-month functional outcome predictions for patients captured by existing AIS-coded datasets.

This review paper outlines the development, construction and validation of the predictive form of the FCI (termed the pFCI), the modifications made which produced the currently available 'revised' pFCI, and the extent to which the revised pFCI has been validated and used.

The original pFCI performed poorly in validation studies. The revised pFCI does not address many of the identified limitations of the original version, and despite the ready availability of a truncated version in the AIS dictionary, it has only been used in a handful of studies since its introduction several years ago. Additionally, there is little evidence for its validity.

It is suggested that the pFCI should be better validated, whether in the narrow population group of young, healthy individuals for which it was developed, or in the wider population of severely injured patients. Methods for accounting for the presence of multiple injures (of which two have currently been used) should also be evaluated.

Many factors other than anatomical injury are known to affect functional outcomes following trauma. However, it is intuitive that any model which attempts to predict the ongoing morbidity burden in a trauma population should consider the effects of the injuries sustained. Although the revised pFCI potentially offers a low-cost assessment of likely functional limitations resulting from anatomical injury, it must be more rigorously evaluated before more comprehensive predictive tools can be developed from it.

Keywords: Functional Capacity Index; major trauma; functional outcomes; 12-month outcomes; trauma scoring; validation; Abbreviated Injury Scale

Background

Forty five years after its introduction, the Abbreviated Injury Scale (AIS)[1] remains the predominant method for scoring the severity of anatomical injury. The scaled severities assigned to each code in the AIS were originally intended to reflect more than mortality.[2] However, it has been known (and re-iterated) since the 1970s that AIS severities are weighted towards the likelihood of mortality.[2-5] In high income countries where mature trauma systems

have brought about significant reductions in mortality, there has been a shift away from focusing on mortality-driven outcomes towards quantifying the extent of morbidity amongst the large proportion of trauma victims who survive their injuries.[6-9] Measurement of functional outcomes was identified as a priority for trauma systems research nearly 20 years ago,[10, 11] but most registries still do not routinely collect outcomes beyond death or hospital-based severity proxies such as length of stay.[8, 11, 12]

The Functional Capacity Index (FCI)[13-15] is "a multi-attribute index that maps anatomic descriptions... of injury [from AIS codes] into scores that reflect the likely extent of functional limitations or reduced capacity at one year post-injury".[13] First developed in the mid-1990s, the FCI was subsequently revised alongside the AIS, and was eventually incorporated into the current (2008) version of the AIS dictionary.[4, 16] As such, the FCI is potentially attractive as a readily available alternative severity predictor using existing AIS-coded datasets.

This paper aims to review the construction and validation of the predictive Functional Capacity Index (termed pFCI), the modifications made to the 'original' version which produced the current 'revised' pFCI and it's truncated version used in the 2008 AIS dictionary (termed pFCI08), and the extent to which this revised tool has been validated and used. This includes appraising the extent to which the revised versions have addressed or overcome limitations identified in the original pFCI. The primary objective of this process is to inform future research using the revised pFCI, and the truncated pFCI08.

Review strategy

The current review involved searches of the general term 'functional capacity index' and the acronym 'FCI' in titles or abstracts of papers referenced in the Scopus, CINAHL, Web of Science and PubMed databases. This was initially performed in late 2015, and updated in September 2016 with the addition of Ovid Embase and Google Scholar. Results not related to the FCI instrument (such as other uses of the acronym) were discarded. Scopus was also used to search for papers referencing critical studies in the development[13, 14] and validation[17-20] of both versions of the FCI. Once all relevant papers were obtained, their reference lists were also reviewed for relevant citations not found elsewhere.

Development and validation of the original pFCI

Construction of the original FCI

The pFCI is an aggregated score, calculated across ten weighted 'dimensions' of function (Table 1). The developers of the original pFCI formulated descriptions of different levels of

function within each dimension; an example of these (for the ambulation dimension) is shown in Table 2.[14] An expert panel was then used to estimate, for each code in the 1990 AIS dictionary, the most likely level of function (in each dimension of function) which would be expected to result 12 months after the injury was sustained.[13, 14] The weights for each dimension, and for each level of function within those dimensions, were derived from the responses of a convenience sample comprising both those familiar with trauma (as staff or patients) and lay people (a mixture of blue- and white-collar workers and college students). For each AIS code, the expected level and dimension scores were mathematically combined to produce an expected overall level of function 12 months following injury. An example of this process (for an AIS spinal injury code) can be seen in Figure 1.

In developing the original pFCI, the assessment of expected functional loss in each dimension for each AIS injury was governed by four assumptions:[13, 14, 21]

i. the individual survives the injury;
ii. the individual is aged between 18 and 34 years and has no prior comorbidities;
iii. the acute care and rehabilitation received is appropriate and timely; and
iv. the injury described is the only injury sustained.

Despite these underlying assumptions, studies have used the pFCI to predict outcomes in wider trauma patient populations. When applied to patients with multiple injuries, prediction of functional loss is often evaluated using the pFCI by assuming that the worst injury (in terms of predicted functional loss) is equivalent to the overall functional loss.[14, 15]

As intended, the pFCI has been the primary use of FCI in published studies, estimating the predicted functional loss in populations of injured patients.[15, 22-28] In particular, the pFCI has been used in studies evaluating large ICD-coded population datasets[22, 23, 26, 27] or crash databases[15, 24, 25, 28, 29] where patient follow-up and outcome assessment is unfeasible. Other applications for the FCI have been suggested, developed or evaluated. These have included using the FCI as an evaluative instrument (either in its entirety [18, 19, 30-32] or using selected dimensions of function [17, 33-36]); as a discriminative tool to identify a study cohort predicted to have functional loss;[18, 37] and as part of a number of approaches to generate estimates of lifetime morbidity in an injured population.[24, 29, 38-41] A detailed discussion of these uses is beyond the scope of this review, although it is relevant to note that the evaluative FCI has been used in studies validating the pFCI. [17-19]

Validation, strengths and limitations of the original FCI

The original pFCI performed poorly in validation studies.[17-19] In one study, moderate correlations were found between the pFCI and other outcome assessments, although it was

suggested that the FCI better discriminated between head-injured patients of differing AIS severity.[18] However, not all of the study data were reported, and the proportion of patients without functional loss at 12 months was at least double that predicted by the pFCI.[18] In a group of patients with lower extremity injury, the predictive FCI demonstrated poor agreement with assessed and self-reported outcomes, and over-predicted good functional recovery.[17] In the most recent validation of the original pFCI, Schluter et al found poor agreement between predicted and observed FCI scores, with a weighted kappa value of only 0.05.[19] This poor validity and an overall lack of evaluation of the pFCI have been commented on in a number of reviews.[11, 42-45]

The novel, multistage approach used in the FCI's development, comprising a mixture of preference-based and expert panel measurements has been highlighted as both a limitation[43, 46] and a strength[47, 48] of the instrument. It has been asserted that predictive tools "represent a professionals' view of the problem rather than the patient's"[43] - although it may equally be observed that expertise in patient assessment does not necessarily translate to expertise in outcome prediction. On the other hand, it has also been suggested that because of 'hedonic adaptation' (where injury sufferers will report similar life satisfaction to pre-injury after a period of adjustment), an expert assessment of function is useful.[47, 48] Considerable variability in rating the impact of functional loss was also seen both between and within different groups of raters used during the FCI's development.[14, 49] Also, the dimensions used in the FCI have been questioned, as dimensions such as emotional and psychosocial outcomes [36, 45] and pain[50] are not considered.

The underlying assumption that the overall disability is equivalent to that of the single worst injury sustained has been questioned. Schluter et al assessed the effects of injuries to different body regions, and found that the pFCI for head injuries and multiply-injured patients with lower extremity fractures under-predicted the observed functional loss.[19] The additional effects of multiple injuries have been noted elsewhere.[51] However, the problem of how best to consider overall functional loss in the presence of multiple disabling injuries has not been further evaluated using the pFCI.

A number of authors have also observed variability in the predictive ability of the pFCI, particularly across levels of injury severity. In addition to the variations between body regions noted by Schluter et al,[19] Kuppa et al also commented that the functional loss associated with some lower extremity injuries to the foot and ankle appeared to be under-estimated by the FCI, but contrasted this by noting that the FCI appeared to over-estimate the severity of femoral shaft fractures.[52] Under-estimation of the functional loss resulting from minor injury has also been observed in cervical spine injuries. Using insurance data from Sweden, Gustafsson et al found that 63% of injured patients with long-term impairment (defined as impairment still

present 3 years post injury) had impairment resulting from 'whiplash'-type injuries to the cervical spine.[53] In another study using the same data source, minor injuries to the cervical spine carried only a 3% likelihood of causing functional loss at 3 years, but accounted for the majority of patients with impairment.[54] These injuries, which are under-represented in hospital admissions data,[55] have only a level 1 severity using AIS, and are not predicted to have functional loss at 12 months using the pFCI.[15] Variability in outcome prediction between more and less severe injury is not unique to the pFCI,[56] but remains an important limitation of this and other panel-derived tools. The considerable population morbidity arising from minor trauma has also been noted elsewhere.[57, 58]

Development of the revised FCI

The development, initial testing and preliminary validation of the original pFCI was sponsored and partly conducted by the U.S. National Highway Traffic Safety Administration.[13-15, 29, 30, 49] Ten years later, the same organisation sponsored the development and dissemination of the revised pFCI,[20, 59, 60] although much of the maintenance of the revised FCI and the derived pFCI08 were undertaken by the European Center for Injury Prevention (ECIP) at the University of Navarra in Pamplona, Spain.[4] Through ECIP, files containing more detailed descriptions of the FCI calculation for each 2008 AIS code (specifically, the level of function expected in each dimension 12 months after a given injury) could be obtained,[4, 27] in the same manner as the detailed descriptions available for the original FCI.[15] However, at the time of writing this manuscript the ECIP web links published in the 2008 AIS dictionary [4] and other sources [27] were no longer valid. As such, it is publicly unclear which organisation or organisations are wholly or jointly responsible for the maintenance and future development of the FCI.

Structure of the revised pFCI

Table 3 illustrates the changes made to the structure of the FCI between the two versions of the instrument. Although the 10 dimensions of function used in the FCI remain unchanged between the versions, most of the numerical data underlying this - the number of levels of function in each dimension; the weighting between these levels; the overall weighting of each dimension in calculating the FCI; and the formula used to summarise the scores - have changed. However, the exact dimension and level weights used in the revised pFCI remain unknown, as at the time of writing this manuscript they have not been published, and the formula for calculation of revised pFCI scores pre-combines dimension and level weights.[21] In the absence of available detailed information regarding the revised pFCI, only the five-level pFCI08 contained in the 2008 AIS dictionary is publicly available.

Although the revised FCI was developed in 2005, much of the information known about this version was not published until a decade later in late 2015 (Table 3).[21] This lack of information about the construction of a widely-available instrument was first noted by Barnes and Morris in 2009.[16] In particular, they commented on the lack of a description for pFCI08 levels 2 to 4 (i.e., some level of impairment, but not maximal impairment).[16] Also, in assuming that the same 'expert panel' approach used in the development of the original FCI had been retained, Barnes and Morris [16] questioned how the approach might have been used in the development of the pFCI08.[16] A recent publication reported that this approach was discarded in the revised FCI in favour of the more commonly used standard gamble technique.[21]

Validation of the revised FCI

For several years, a brief 2005 paper provided the only preliminary 'validation' of the revised FCI.[20] This paper provided a brief overview of the substantial changes made in the development of the 2005 revision of the AIS, and noted that the FCI had been revised concurrently.[20] Also contained was a brief descriptive comparison of the pFCI scores (for both FCI versions) for eight patients with lower extremity fractures whose levels of function were assessed 12 months following injury. It was asserted that pFCI scores for the revised FCI were more closely associated with the measured outcomes than the original pFCI scores,[20] although both were poorly correlated with different sub-scores of the generalised Short Form 36 (SF-36).[37, 43] Also, as there were inconsistencies between the revised pFCI scores for the injuries given in this paper [20] and the summarised pFCI08 severities in the 2008 AIS dictionary,[4] it may be that this preliminary analysis [20] was performed using an early, unpublished version of the 2005 AIS, which was not definitively standardised until the publication of the 2008 AIS dictionary.[61]

A 2016 paper by McMurry et al sought to validate the revised pFCI against patient-reported physical component scores (PCS) using the SF-36.[62] Three methods were used - an assessment of correlation between the revised pFCI and SF-36 PCS; the fitting of a regression model predicting SF-36 PCS including the pFCI; and a review of outliers (patients for whom the pFCI under- or over-predicted outcome).[62] However, there were several limitations with the methods used. Firstly, more than 90% of the AIS-coded data used was migrated from the 1998 to the 2008 AIS versions based solely on the incomplete map contained in the 2008 AIS dictionary;[62] it has been identified that using this method results in inaccurate summary scores in a substantial proportion of patients.[63] Secondly, an unvalidated method of combining pFCI scores in patients with multiple disabling injuries was used.[62] Thirdly, although a weak correlation of 0.24 (using unstated methods) was found between the 40-point pFCI and the 100-point PCS,[62] the linearity of this association was not evaluated (or at least was unreported).

As the pFCI (ranging between 60 and 100) and the PCS (ranging between 0 and 100) are also measured using different scales, correlation is unlikely to be informative in linking predictive pFCI scores with assessed outcomes. Fourthly, although the revised pFCI was identified as a significant predictor of outcome using a regression model, it was just one of 18 predictors in the model which were significant at a 95% confidence level.[62] As a result, this paper did not provide sufficient evidence to validate the revised pFCI in predicting functional outcomes.

Use of the revised FCI

To date, only five papers have used the revised FCI.[16, 21, 64-66] Barnes and Morris used a crash dataset to compare the functional loss predictions from the pFCI08 (based on the 2008 AIS) with those from the earlier Injury Impairment Scale (IIS, based on 1990 AIS codes).[16] Because the study did not assess actual outcomes following injury, the predictive performances of the two tools could not be compared. The primary findings were that the proportion of patients expected to have functional loss at 12 months was lower for the pFCI08 than for the IIS, and that in the population evaluated there were differences in the body regions predicted to contribute most to population morbidity.[16] The authors speculated that in part this may have been due to changes in the coding of head and lower extremity injuries between the 1990 and 2008 versions of the AIS.[16]

Poplin et al used the pFCI08 to predict functional loss in a cohort of fire department employees who sustained occupational injury.[66] In their population, 18% of injured employees were predicted to have functional loss as a result of the injuries they sustained.[66] However, the majority of injuries sustained which required time off work were minor sprains and strains for which the pFCI does not predict functional loss.[66] It was conceded that short-term loss of function was unlikely to be accurately measured by the 12-month pFCI08.[66]

In two separate papers, Breeze and colleagues used computer modelling (based on injury data from a military trauma registry) to predict changes in the pFCI08 and 2008 AIS ratings of injury severity which would result from the introduction of, or modifications to a range of facial armour configurations.[64, 65] The AIS and pFCI08 were not significantly different from clinical findings in the same patients (based on mean pFCI08),[65] and worse outcomes on both AIS and pFCI08 were demonstrable for patients not wearing ballistic eye protection.[64] However, because of the method used for evaluating pFCI08, and the study focus on the protection worn, no validation between the observed and predicted pFCI08 scores was obtained.

In 2015, McMurry et al used crash study data to assess predicted years of life lost to injury and associated costs for a 14-year cohort of patients.[21] The majority of patients were coded using earlier versions of the AIS, and a novel mapping technique was used to convert these AIS

codes to 2008 AIS equivalents (and hence derive pFCI08 values).[21] This methodology was able to calculate estimates of population morbidity and costs using pFCI08 data. However, the accuracy of these estimates was not assessed against any other measures of morbidity or cost.

Assessment of the extent to which earlier FCI limitations have been overcome

Generally, the limitations of the original FCI have not been addressed by the revised FCI. Barnes and Morris noted that pain was a "major factor" affecting function;[16] however this could not be assessed using either the original or the revised FCI as the dimensions of function covered by the instrument did not change. Both Barnes and Morris, and Poplin et al also identified 'neck strain' injury - which the pFCI08 predicts is unlikely to result in functional loss at 12 months - as a cause of significant impairment in many patients;[16, 66] the former paper also commented that the pFCI08 continues to under-estimate functional loss from lower extremity injury.[16] Some of these findings were corroborated by McMurry et al (2016),[62] who found that spinal fractures expected to fully recover according to the revised pFCI made up the majority of 'unexpected' functional loss at 12 months post-injury.[62] However, the same study also found that lower limb fractures for which the pFCI predicted functional loss occurred in the majority of patients with an 'unexpected' full recovery as assessed using the SF-36 PCS.[62] This suggests that not all lower extremity injuries are under-estimated by the revised pFCI. From the data presented, though, it appears likely that the pFCI08 scores for some comparatively minor injuries continue to over-predict functional recovery. Barnes and Morris also criticised the tendency of the pFCI08 to vary in the prediction of head injury outcomes only between no impairment and maximal impairment, with few injuries predicted to result in moderate levels of impairment.[16] McMurry et al (2016) found that the revised pFCI also varied in its ability to predict outcomes from head injury, with full recovery being assessed in some patients with poor pFCI predictions, but substantial functional loss occurring in some patients who were expected to fully recover according to the pFCI.[62]

There remains little agreement about the best method for accounting for the presence of multiple injuries in a single patient - particularly multiple injuries with a pFCI08 predicting functional loss. McMurry et al (2015) re-iterated the 'worst injury' technique that was advocated for the original pFCI, as well as suggesting an alternate technique referred to as 'whole body FCI' which involved combining the worst injuries in each dimension of function and combining them into a new, patient-specific FCI.[21] This technique was re-used in the later validation study by McMurry et al (2016).[62] It requires information on specific dimension and level weights, similar to the formula for original pFCI scores and unlike the formula stated to calculate pFCI08 scores (Table 3). However, although these weights for the revised FCI were available to

McMurry and colleagues [21, 62] they are not currently publicly available and the validity (or superiority) of this method cannot be broadly assessed.

Finally, the four assumptions which governed the assignment of codes in the original pFCI [13, 14] remain for the pFCI08 [21] - namely, that the levels of functional loss predicted by the pFCI to be present at 12 months assume that the patient is young, previously healthy, received good medical care and sustained a single disabling injury. The section of the 2008 AIS dictionary that discussed the FCI confirmed the assumptions with the exception that FCI assignment was "for a subject aged 18 to 65".[4] As this is the only instance where this different age group is stated, it is possible that this was misprinted. However, it should be noted that the selection of the 18 to 34 year age group has never been validated, and may itself be arbitrary.

The future: FCI2015 and directions for research

Although it has been more than a decade since the revised FCI was developed, and eight years since the publication of the pFCI08 in the widely-adopted 2008 AIS,[4] evidence for the validity of this instrument is lacking. Few studies have used the pFCI08, and although these have demonstrated that the pFCI08 could potentially be used in a number of ways none have been able to fully gauge the accuracy of outcome predictions made by the pFCI08. With a new AIS version due,[67] it is important that the pFCI08 be further validated to adequately assess its potential to add a morbidity prediction to the mortality-biased severity estimates provided by AIS scores.

Future validation could consider whether the pFCI is valid in the population for which it was intended[13, 14, 21] - namely, young and previously healthy patients who have sustained isolated injury - as well as testing these assumptions by assessing the pFCI in a broader population. Furthermore, because many severely injured patients sustain multiple injuries, data about how best to use the pFCI08 when multiple injuries are present is needed. Related to this is the need to ensure that (or evaluate whether) the pFCI08 performs equally across different body regions. The technique employed by McMurry and colleagues [21, 62] to calculate 'whole body' pFCI08 scores for each patient also warrants further consideration, but would require more detailed data on dimension and level weights for the revised FCI to be made publicly available. At present, only the truncated scores available in the 2008 AIS dictionary are widely accessible.

Anatomical injury severity scores have been found to explain only a small proportion of the variability in observed trauma outcomes.[19, 26] Conversely, many other factors have been found to independently predict outcomes 12 months or more post injury. These include:

- pre-injury factors such as education level,[48, 68] age,[57, 68-73] gender[57, 73, 74] and comorbid status;[48, 57, 71, 73]

- injury event factors such as the intent[71, 73] and mechanism[71, 73] of injury, the Injury Severity Score,[70, 72] or the presence of serious injury to the extremities,[48, 57, 70-72, 75] brain[48, 70, 71] or spinal cord;[48, 57, 71, 73]
- hospital-related factors such as the level of hospital providing definitive care,[70] length of ICU stay,[68, 75] length of hospital stay,[68, 72] the discharge destination [70] or the occurrence of complications;[76] and
- post-discharge factors such as pain levels,[68] compensability,[68, 70, 71, 73] and the presence of depression or PTSD.[75]

The extent to which some of these factors affect outcomes has varied between studies, or their effects have been found to be limited to particular aspects of function. In addition, it is likely that many of the models evaluated for outcome prediction have not included all potential explanatory factors. Nevertheless, predictions based solely on anatomic injury (as the pFCI attempts to achieve) are unlikely to be sufficiently accurate for prognostic use. However, the component of long-term functional loss attributable to the anatomical injuries sustained should be identified.[30] Only then can further progress be made towards a better, more inclusive prognostic model for predicting functional outcome after severe injury.

Limitations

It is possible that other research not discussed in this review has evaluated the pFCI. This review was not designed as a systematic review per se, but used a broad search strategy employing a variety of complementary databases with coverage of non-English journals and 'grey literature'.[77, 78] This is exemplified by the identification of conference posters, and published abstracts and conference proceedings by the search.[27, 30, 50, 52, 64] Also, many of the papers identified by the search strategy were themselves reviews on injury outcomes, or functional or quality of life assessment; this provided additional opportunity to identify studies of interest although no additional studies were identified.

Conclusion

The revised pFCI offers the potential to predict functional outcomes using existing AIS codes. However, it is not well-validated, not readily accessible and does not have an agreed methodology for its use, particularly when multiple injuries are present. The truncated pFCI08 is widely-available, and hence could potentially facilitate predictions of the morbidity burden arising from injury using current AIS scoring. This would be able to address ongoing calls for the assessment of morbidity in trauma populations.[12] However, the pFCI08 is currently not validated. A number of identified issues with pFCI08 scores, including the variability in

predictive ability across anatomical regions and severity levels, and methods for accounting for multiple injuries also require assessment. These issues pose a barrier to the ideal of low-cost and reliable assessment of likely functional outcomes across an injured population, including the development of more comprehensive predictive tools.

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Figure 1

Calculation of pFCI for a single AIS code. Level weights taken from MacKenzie et al[13] are applied to the formula in MacKenzie et al[14] to derive the FCI value provided by Segui-Gomez.[15]

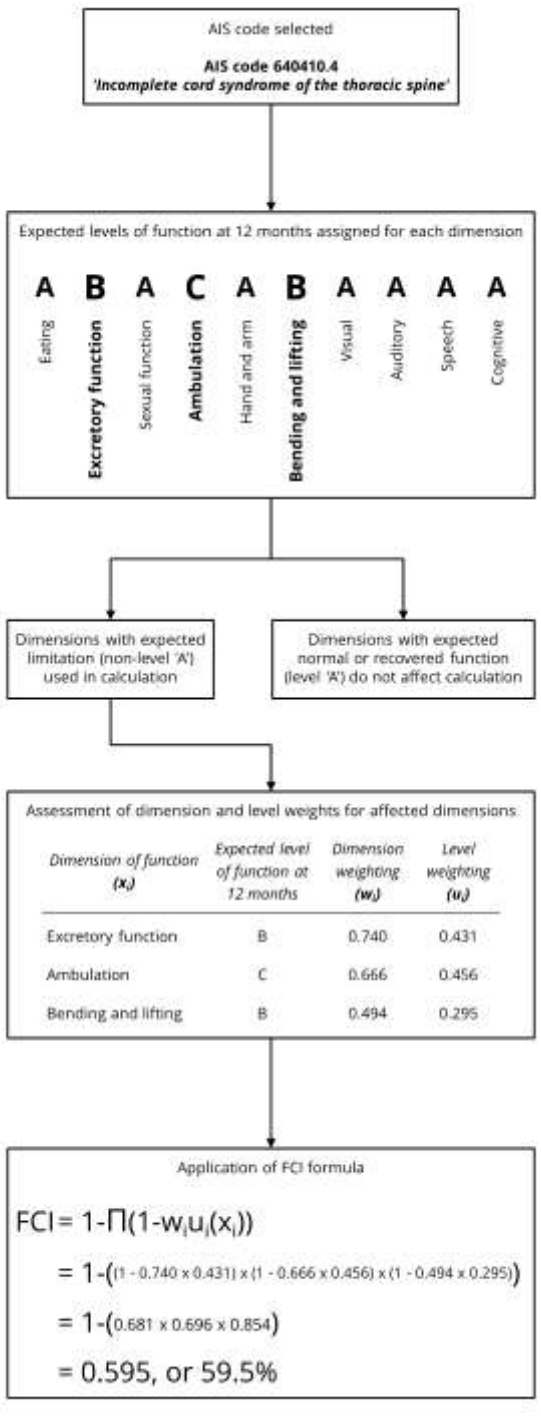

Table 1. Dimensions and levels of function comprising the original FCI.[12, 13]

Dimension of function	Levels of function	Dimension weighting (percentage)	Expected percentage loss of function for each level of function						
			A (no limitation)	B	C	D	E	F	G
Eating	3	75.2	0.0	38.2	100.0	-	-	-	-
Excretory function	4	74.0	0.0	43.1	74.6	100.0	-	-	-
Sexual function	3	45.7	0.0	49.7	100.0	-	-	-	-
Ambulation	6	66.6	0.0	21.8	45.6	68.5	80.6	100.0	-
Hand and arm	6	75.0	0.0	31.0	57.9	54.3	81.0	100.0	-
Bending and lifting	4	49.4	0.0	29.5	64.6	100.0	-	-	-
Visual	7	41.3	0.0	47.3	34.7	51.8	80.3	89.0	100.0
Auditory	5	34.8	0.0	19.6	36.5	66.8	100.0	-	-
Speech	4	68.5	0.0	29.6	65.6	100.0	-	-	-
Cognitive	6	100.0	0.0	26.7	49.9	78.2	92.5	100.0	-

Table 2. Brief descriptions of the six levels of function used for FCI assessment within the ambulation dimension of function.[14]

Level	Description	Expected percentage loss of function at level
A	No limitations	0.0
B	Independent without device, but has minor limitations in amount of running or vigorous walking appropriate to age	21.8
C	Independent but may require device; takes more than reasonable amount of time to walk and/or climb stairs	45.6
D	Can walk a minimum of 150 feet but only with assistance	68.5
E	Amount of walking generally limited to 150 feet with or without assistance	80.6
F	Severe difficulty in standing and walking a minimum of 50 feet, including not being able to do it at all	100.0

Table 3. Comparison between structure of original and revised versions of the FCI.

	Functional Capacity Index (1994, 1996) [13, 14]	**Revised Functional Capacity Index (2005, 2008)** [4, 20]
AIS version used for predictive FCI	1990 [15]	2008 update [4]
Method of disability assessment	Combination of preference-based and expert panel[13, 14]	Standard gamble technique [21]
Number of health states per FCI dimension	48 states in total [14, 15]	40 states in total [79]
- eating	3	3
- excretory function	4	3
- sexual function	3	3
- ambulation	6	5
- hand & arm function	6	5
- bending and lifting	4	4
- visual function	7	4
- auditory function	5	3
- speech	4	4
- cognitive function	6	6

	Functional Capacity Index (1994, 1996) [13, 14]	**Revised Functional Capacity Index (2005, 2008)** [4, 20]
Formula used to calculate FCI scores	$FCI = 1 - \prod_{i=1}^{10} \left(1 - w_i u_i(x_i)\right)$	$FCI = 40 \times \prod_{d=1}^{10} \left(\frac{FCI_d - 60}{40}\right) + 60$
Range of pFCI scores obtained	0 (no limitation) to 100 (worst), expressed as percentage [21]	60 (worst) to 100 (no limitation) [21]
Range of summary scores used in AIS-based pFCI	1 (minor limitation) to 5 (worst); no limitation not included [15]	1 (worst) to 5 (no limitation) [4]
Method for deriving summary scores	AIS injuries with expected limitation divided into 20% bands of percentage functional loss [15]	AIS injuries with expected limitation fairly evenly divided between scores 1-4 [21]
AIS codes with expected limitation in pFCI	321 of 1,312 (24.5%) [15]	619 of 1,999 (31.0%) [4]
AIS codes excluded from pFCI evaluation	40 of 1,312 (3.0%) [15]	103 of 1,999 (5.2%) [4]
Type of AIS codes excluded from pFCI evaluation	Skin injuries (including burns), with some exceptions[15]	Mostly 'whole region (NFS)' injuries, burn injuries and 'other trauma' section of AIS External chapter[4]