

## ORIGINAL PAPER

# Utility of the modified 5-item frail index to predict complications and reoperations after hallux valgus surgery



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### KEYWORDS

Hallux valgus deformity;  
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### Abstract

**Introduction:** The modified 5-item frailty index (mFI-5) has been recently proposed as a useful tool for predicting postoperative complications in orthopedic surgery. We aimed to analyze the utility of this score in predicting complications and reoperations after hallux valgus (HV) deformity surgery.

**Methods:** 551 patients undergoing percutaneous HV corrective surgery were retrospectively reviewed. The mFI-5 was calculated based and patients were categorized in three groups: (1) non-frail: patients without any of the 5 comorbidities, (2) pre-frail: patients with one comorbidity and (3) frail: patients with two or more comorbidities. Complications and surgical reoperations were recorded.

**Results:** In the study period 772 percutaneous surgeries were performed to correct hallux valgus deformity, 551 patients were included with a median age of 60 (IQR 48–70). 389 patients were non-frail (70.6%), 132 were pre-frail (23.9%) and 30 were frail (5.4%). 75 patients suffered complications (13.6%). Even though the rate of complications was higher in frailty patients (23.3%) compared with pre-frail (13.6%) and non frail (12.8%), no significant differences were observed among groups. 48 patients required reoperation (8.7%) but the rate of reoperations among frailty groups was not significantly different ( $p=0.11$ ). Frailty patients had worse AOFAS scores at final follow up ( $p=0.011$ ).

**Conclusion:** The mFI-5 was not useful to predict postoperative complications and reoperations after hallux valgus corrective surgery. Therefore, other factors should be considered when analyzing the risk of complications after HV corrective surgery.

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**PALABRAS CLAVE**

Hallux valgus;  
Índice de fragilidad;  
Complicaciones;  
Reoperaciones

## Utilidad del índice de fragilidad modificado de 5 ítems para predecir complicaciones y reoperaciones después de la cirugía percutánea de hallux valgus

**Resumen**

**Introducción:** El índice de fragilidad modificado de 5 ítems (mFI-5) se ha propuesto recientemente como una herramienta útil para predecir complicaciones postoperatorias en cirugía ortopédica. Nuestro objetivo fue analizar la utilidad de esta puntuación en la predicción de complicaciones y reoperaciones después de la cirugía de hallux valgus (HV).

**Métodos:** Se revisaron retrospectivamente 551 pacientes sometidos a cirugía percutánea de HV. Se calculó el mFI-5 y se clasificó a los pacientes en tres grupos: 1) no frágiles: pacientes sin ninguna de las 5 comorbilidades; 2) pre-frágiles: pacientes con una comorbilidad, y 3) frágiles: pacientes con dos o más comorbilidades. Se registraron complicaciones y reoperaciones.

**Resultados:** En el período de estudio se realizaron 772 cirugías percutáneas para corregir la deformidad del HV, y se incluyeron 551 pacientes con una mediana de edad de 60 años (RIC 48-70). De ellos, 389 pacientes no eran frágiles (70,6%), 132 eran pre-frágiles (23,9%) y 30 eran frágiles (5,4%). Setenta y cinco pacientes sufrieron complicaciones (13,6%). Aunque la tasa de complicaciones fue mayor en los pacientes frágiles (23,3%) en comparación con los pre-frágiles (13,6%) y los no frágiles (12,8%), no se observaron diferencias significativas entre los grupos. Cuarenta y ocho pacientes requirieron reoperaciones (8,7%), pero la tasa de reoperaciones entre los grupos de fragilidad no fue significativamente diferente ( $p=0,11$ ). Los pacientes frágiles tuvieron peores puntuaciones AOFAS en el seguimiento final ( $p=0,011$ ).

**Conclusión:** El mFI-5 no fue útil para predecir complicaciones postoperatorias ni reoperaciones después de la cirugía de HV. Por lo tanto, se deben considerar otros factores al analizar el riesgo de complicaciones después de la cirugía del HV.

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**Introduction**

Hallux valgus (HV) deformity is commonly seen in medical practice because it causes significant functional disability and foot pain.<sup>1</sup> The prevalence in the general population has been estimated between 23% and 35.7% and increases with age.<sup>1,2</sup> Usually, non-surgical treatments are the first options in order to manage the symptoms and not to treat the deformity. Because the deformity cannot be reduced with non surgical treatments. If this treatment fails, surgical repair should be considered.<sup>3</sup> Modern orthopedic surgery uses minimally invasive techniques (MIS) to mitigate some of the risks of open surgery, reducing soft tissue injury and speeding recovery.<sup>4</sup> The rise of minimally invasive surgery in the last decade has led to the use of this resource to solve mild to severe forefoot deformities such as HV.<sup>5-8</sup> There are current publications on how successful forefoot surgeries are and what type of complications this surgical technique entails.<sup>4,7,9,10</sup>

However, as the population ages, the prevalence of HV deformity is expected to increase as well as the prevalence of comorbidities. In this regard, elderly patients seeking treatment for HV poses a relatively higher risk of complications. Moreover, frailty syndrome – an age related status – has shown to be strongly associated with adverse outcomes in patients after different types of surgeries.<sup>11</sup> Frailty refers to the decline in physiological function, resulting in an increased susceptibility to stressors such as surgery. To evaluate preoperative risk factors for adverse surgical outcomes, a modified frailty index was developed.

Initially consisting of eleven factors, it was later reduced to five key factors: functional status before surgery, history of diabetes mellitus, chronic obstructive pulmonary disease (COPD), congestive heart failure (CHF), and hypertension (HTN) requiring medication. Various studies in different medical specialties have shown that the modified frailty index with five factors (mFI-5) is just as effective in predicting postoperative complications and mortality as the original eleven-factor modified frailty index (mFI-11).<sup>12</sup>

As far as we know, the effectiveness of the mFI-5 to predict complications after MIS hallux valgus repair has not been previously analyzed. Therefore, the objective of this study is to determine the predictive ability of the mFI-5 in terms of complications and reoperations following MIS hallux valgus repair.

**Methods**

A retrospective study of consecutive patients undergoing HV corrective surgery between January 2015 and December 2020 at a single academic institution was performed. Institutional review board approval was obtained to conduct this study (IRB:00010193) and the study adheres to the ethical principles of the Helsinki declaration.

Patients 18 years and older, with indication for HV percutaneous surgery due to primary progressive deformity were included. Only patients operated by using a percutaneous distal metaphyseal osteotomy with lateral displacement (Bosch and chevron osteotomies) fixed with two cannulated screws were included. Weight-bearing was allowed

**Table 1** Baseline characteristics.

Variable	Total (n = 551)	Non-frail (n = 389)	Pre-frail (n = 132)	Frail (n = 30)	p
Age	60 (48–70)	56 (42–66)	69 (60–73)	71.5 (66–74)	<b>0.001</b>
Females	485 (88%)	355 (91.2%)	124 (93.9%)	6 (20%)	<b>0.001</b>
BMI	25.6 (23–29)	24.5 (22.4–27.9)	26.6 (24.8–29.7)	30.9 (28.7–33.3)	<b>0.0001</b>
Smoking	34 (6.2%)	25 (6.4%)	6 (4.5%)	3 (10%)	0.49
Complications	75 (13.6%)	50 (12.8%)	18 (13.6%)	7 (23.3%)	0.27
Reoperations	48 (8.7%)	39 (10%)	9 (6.8%)	0 (0%)	0.11

BMI: body mass index. Significant values are expressed in bold.

immediately with a postoperative shoe. The cures were performed weekly for four weeks.

Patients were excluded if they were under 18 years old, underwent revision surgery, history of hallux fracture or infection, incomplete records or had postoperative follow-up of less than 6 months. Preoperative factors collected included age, sex, body mass index (BMI), past medical history, comorbidities and previous surgical status within 30 days. Intraoperative and postoperative complications and reoperations were recorded. Any unplanned readmission and mortality were also collected. For functional evaluation, the American Orthopedic Foot and Ankle Society (AOFAS) scale was used at the preoperative time and at final follow-up.<sup>13</sup>

The mFI-5 includes the following comorbidities: (1) history of congestive heart failure (CHF), (2) presence of insulin-dependent or non-insulin-dependent diabetes mellitus, (3) history of chronic obstructive pulmonary disease (COPD) or pneumonia, (4) partially dependent or totally dependent functional health status at time of surgery, and (5) presence of hypertension requiring medication. Each factor is given a weight of 1 if the comorbidity is present and 0 if absent. The mFI-5 was calculated based on the number of factors present for a patient out of the 5 factors included in the index. Patients were categorized in three groups: (1) non-frail: patients without any of the 5 comorbidities included in the mFI-5, (2) pre-frail: patients with one comorbidity and (3) frail: patients with two or more comorbidities, according to previous studies.<sup>14,15</sup>

## Statistical analysis

Categorical variables were described as their absolute and relative frequency with percentages. All continuous variables were checked first for normal distribution by applying the Shapiro–Wilk test. The quantitative variables were described as mean and standard deviation (SD) or median and interquartile range (IQR) according to the observed distribution. Comparisons among the categorical variables (complications, reoperations, smoking, sex) were made between the different groups (non-frail, pre-frail and frail) using global Chi-square. The continuous variables (age, AOFAS score and body mass index = BMI) were compared between the groups with one-way ANOVA and Kruskal–Wallis, according to distribution. Univariable and Multivariable logistic regressions were applied to examine the relationship between frailty score and complications. It was considered a significant association if  $p < 0.05$ . The

statistical analysis was performed with the software STATA 13.1.

## Results

In the study period 772 percutaneous surgeries were performed to correct hallux valgus deformity. Finally, 551 patients were included in our study with a median age and IQR of 60 (48–70). 389 patients were classified as non-frail (70.6%), whereas 132 were considered pre-frail (23.9%) and 30 were frail (5.4%). Baseline characteristics are illustrated in [Table 1](#).

### Frailty score and complications

75 patients suffered complications (13.6%), the most common complications observed were prominence of the screws under the skin (17.3%), wound infection (10.6%) and loss of correction (9.33%). Even though the rate of complications was higher in frailty patients (23.3%) compared with pre-frail (13.6%) and non frail (12.8%), no significant differences were observed among groups. On the other hand, age and BMI were significantly higher in frailty patients compared with non and pre-frailty cohorts whereas the percentage of females was significantly lower in the frailty group ([Table 1](#)).

### Frailty score and reoperations

48 patients required reoperation (8.7%), the most common re-interventions were osteosynthesis extraction (72.9%), realignment surgery (10.4%) and surgical toilettes (6.2%). The reoperations were as a consequence of the most frequent complications. The percentage of reoperations among frailty groups was not significantly different ( $p = 0.11$ ) ([Table 2](#)).

### Frailty score and preoperative and postoperative AOFAS

Comparison among preoperative AOFAS was performed among the 551 patients included, no significant differences were observed among subgroups. Regarding postoperative AOFAS, 332 patients had a minimum of 6 months AOFAS score and were compared among frailty cohorts. Significant differences were observed between non frail and pre/frail subgroups, however between pre-frail and frail there were no differences ([Table 3](#)).

**Table 2** Complications and reoperations.**Complications (n = 75)**

Prominence of osteosynthesis	13 (17.3%)
Superficial wound infection	8 (10.6%)
Loss of correction	7 (9.3%)
Loosening of osteosynthesis	6 (8%)
Transfer metatarsalgia	6 (8%)
Joint stiffness	6 (8%)
Pain	5 (6.6%)
Skin burn/wound dehiscence	5 (6.6%)
Delayed union	4 (5.3%)
Intraarticular migration of osteosynthesis	3 (4%)
Deep wound infection	3 (4%)
Osteosynthesis breakage	2 (2.6%)
Distal metatarsal articular angle (DMMA) overcorrection	2 (2.6%)
Disuse osteoporosis/Pseudarthrosis/Asymptomatic avascular necrosis/Medial cortical fracture/Complex regional pain syndrome	1 (1.3%)

**Reoperations (n = 48)**

Osteosynthesis extraction	35 (72.9%)
Realignment surgery	5 (10.4%)
Surgical toilettes	3 (6.2%)
Exostectomies	2 (4.1%)
Pseudarthrosis surgery	1 (2%)

## Discussion

The relatively new mFI-5 item frailty score has shown to effectively predict the risk of complications and reoperation in different general and orthopedic surgeries. To our knowledge, the use of the mFI-5 was not previously analyzed in HV percutaneous corrective surgery. In this regard, the mFI-5 items score was not able to predict the risk of complications or reoperations after HV corrective surgery, besides the trend observed to higher rate of complications in frailty compared with non-frailty patients, the difference was not statistically significant. The utility of the mFI-5 has been assessed in different orthopedic procedures. Traven et al.<sup>16</sup> found that mFI-5 items was a strong predictor of postoperative complications, readmission and mortality after hip and knee arthroplasty in 226,398 patients using the American College of Surgeons National Surgical Quality Improvement Program's database. Similar results were observed by the same author in total shoulder arthroplasty.<sup>17</sup> In spine surgery, Pierce et al.<sup>18</sup> analyzed 234,138 patients, showing a similar effect of the mFI 5-factor in predicting postoperative complications after elective spine surgery. Similar results were observed by Camino-Willhuber et al.,<sup>19</sup> Shah et al.,<sup>20</sup> and Chat et al.<sup>21</sup>

in elective posterior spinal fusion, adult spinal deformity, and spondylolisthesis patients, respectively. This shorter version of the 11-item index has also shown a positive correlation between frailty and complications in trauma as in vertebral compression fractures treated with kyphoplasty published by Segal et al.<sup>18</sup> and distal radial fractures by Wilson et al.<sup>15</sup>

The use of this modified frailty score in foot and ankle surgery was reported by Akti et al.,<sup>22</sup> the authors analyzed 94 patients over 65 years of age that underwent surgery for ankle fractures in a single institution and observed that mFI-5 was a sensitive tool to predict complications and readmission with even higher sensitivity than American Society of Anesthesiologist, body mass index and age.

Regarding the BMI, it was significantly higher in frailty patients compared to non-frailty and pre-frailty cohorts ( $p \leq 0.0001$ ). Even though obesity has been associated with higher complications in orthopedic surgery,<sup>23</sup> recent studies have not found an association with higher complications and reoperations in percutaneous surgery for treating hallux valgus in obese patients.<sup>24</sup>

Our study has some limitations, as previously mentioned, this is retrospective, single-center experience and the number of patients compared with multicenter databases is relatively low, however, this is the first study analyzing the utility of the frailty score in predicting complications in type of surgery and the results should not be underestimated. It is also worth mentioning that the mFI-5 only considers a patient's comorbidities and does not take other aspects of the frailty syndrome such as cognition and function, therefore, the results from this score should be cautiously interpreted among other components of the broader concept of frailty. Even though the mFI-5 has been shown to be effective in predicting adverse events in different procedures, the utility of this tool might be limited in surgeries with a low complication rate, such as HV surgery. More studies assessing the use of this mFI-5 in foot and ankle surgery are warranted to understand its usefulness as a preoperative risk assessment tool.

## Conclusion

Even though frailty patients exhibited higher rates of complications and lower clinical outcomes at last follow-up, preoperative risk assessment by using the mFI-5 did not evidence significant differences among groups in terms of complications and reoperations. Therefore, the utility of the mFI-5 in HV surgery might not be a sensitive tool to assess preoperative risk in terms of complications and reoperations.

**Table 3** Comparison of preoperative and postoperative AOFAS score among frailty status cohorts.

Variable	Non-frail (mean/SD)	Pre-frail (mean/SD)	Frail (mean/SD)	<i>p</i>
Preoperative AOFAS	58.6 (13.2)	55.2 (14.9)	54.4 (18.1)	0.06
Postoperative AOFAS	94.3 (7.3)	91.2 (10)	91.6 (7)	<b>0.011</b>

AOFAS: American Orthopedic Foot and Ankle Society; SD: standard deviation. Significant values are expressed in bold.



## Level of evidence

Level of evidence III.

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## Conflict of interest

The authors declare no conflicts of interest.

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