

Is the 5-factor modified Frailty Index a prognostic marker in geriatric ankle fractures?

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ABSTRACT

BACKGROUND: The 5-factor modified Frailty Index (mFI-5), which is the latest version of the Frailty Index, is a tool that calculates the risk of complications after treatment by scoring the comorbidity status of the patient. The aim of this study was to evaluate the efficacy of the mFI-5 in predicting complications in geriatric patients with an ankle fracture.

METHODS: A retrospective examination was made of a total of 94 patients aged >65 years who were treated for an ankle fracture in our hospital between 2015 and 2020. Weber type A, B, and C fractures were included in the study. For each patient, the mFI-5 was calculated for the comorbidity status of diabetes, chronic obstructive pulmonary disease, congestive heart failure, hypertension requiring drugs, and non-independent functional status. Multivariate logistic regression analysis was used to evaluate the mFI-5 points as a predictor of negative outcomes.

RESULTS: The mFI-5 was observed to be effective in the prediction of the complications of hospital re-admission, wound site infection, life-threatening medical complications, and the presence of any complication ($p<0.05$). In the prediction of whether or not there was any complication, the mFI-5 was determined to be a more effective tool than body mass index, American Society of Anesthesiologist, age, length of stay in hospital, and duration of operation ($p<0.05$, OR=2.726, 95% Confidence Interval=1.285–5.783).

CONCLUSION: The mFI-5 is a sensitive tool for the prediction of complications which may develop following geriatric ankle fracture. The five comorbidities which constitute the mFI-5 are easily obtained from the patient anamnesis, and this renders it a practical clinical tool to identify high-risk patients, determine the preoperative risks, and improve the health-care service.

Keywords: Ankle fracture; comorbidity; complication; Frailty Index.

INTRODUCTION

As a result of advances in technology and new medical discoveries, mean life expectancy is increasing and the elderly population as a proportion of the whole population is increasing worldwide.^[1] Therefore, the care and treatment of elderly patients is increasing in importance. Orthopaedic diseases have an important place among the reasons for presentation at hospital of the geriatric population. Previous research has reported that within 1 year, at least 1 of every 3 elderly individuals will fall and approximately 20% of those falls will result in a serious fracture.^[2] Ankle fracture is the third most commonly seen fracture in the elderly population.^[3]

The relationship of osteoporosis in the etiology of geriatric ankle fractures is not clear. As torsional mechanisms are effective in the formation of these fractures in all age groups, there are studies in literature that have stated that there is no significant difference in the incidence of ankle fractures at middle age and advanced age.^[4,5] Moreover, this does not change the treatment strategy. Just as in other age groups, the main aim in the treatment of ankle fractures in the elderly population is anatomic restoration of the tibiotalar mortice.^[6] If the fracture is non-displaced, treatment of cast immobilisation is applied for 6 weeks. If the fracture is displaced, despite the high complication rates compared to the young adult population, surgical treatment is recommended.^[7-9] The

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ability to predict potential complications provides great advantages in respect of both costs and determining the appropriate treatment.

Many studies have been published on predicting complications that may occur in the treatment of geriatric ankle fractures and in the treatment of other orthopedic diseases.^[7,10,11] These studies have identified several calculation tools for the prediction of high-risk patients, primarily the Charlson Comorbidity Index, the Elixhauser Comorbidity Method, the Score for Trauma Triage in the Geriatric and Middle-Aged (STTGMA), and multiple versions of the Frailty Index.^[11-13]

The aim of these risk calculating tools is to measure the physiological reserve risk. The 5-factor modified Frailty Index (mFI-5), which is the latest version of the Frailty Index includes the status of five comorbidities. These are diabetes mellitus (DM), hypertension (HT) requiring treatment, chronic obstructive pulmonary disease (COPD), congestive heart failure (CHF), and non-independent functional status.^[14] Many recent studies have reported use of the mFI-5 for the prediction of complications in geriatric patients applied with rotator cuff repair, knee and hip arthroplasty, and surgery for hip fracture and radius distal end fracture.^[15-18]

To the best of our knowledge, no previous study has used the mFI-5 to determine the prognosis of geriatric ankle fractures. Therefore, the aim of this study was to evaluate the efficacy of the mFI-5 in the prediction of complications in geriatric patients with ankle fracture. The hypothesis of the study was that the mFI-5 would be a strong predictor for postoperative disease and mortality following geriatric ankle fractures.

MATERIALS AND METHODS

Approval for the study was granted by the Local Ethics Committee. Patients were identified by scanning the electronic medical records of the regional Training and Research Hospital. The study included patients aged >65 years who were treated for an ankle fracture in our hospital between 2015 and 2020. Fractures not including the medial, lateral, and posterior malleolus were excluded from the study. A record was made for each patient of age, gender, length of hospital stay, operating time, body mass index (BMI), American Society of Anesthesiologist (ASA) grade, and diagnosed comorbidities.

The mFI-5 score is formed from the status of 5 comorbidities. These are DM, HT requiring treatment, COPD, CHF, and non-independent functional status. One point is given for each of the comorbid diagnoses present.

If the patient had a diabetes status that could be treated with dietary control, it was not evaluated as DM. Diabetes that required antidiabetic agent treatment for ≥ 2 weeks was evaluated as DM. HT requiring treatment for ≥ 2 weeks was evaluated as HT. A diagnosis of COPD was made according to

two criteria. The first of these was a historical or current diagnosis of COPD, and the second was at least one of the following: (1) a functional disability resulting from COPD such as dyspnea or inability to perform activities of daily living; (2) requirement for chronic bronchodilator therapy with oral or inhaled agents; (3) previous hospitalization for treatment of COPD; or (4) a forced expiratory volume in 1 s of <75% of a previous pulmonary function test. CHF was accepted as a diagnosis documented within 30 days before the index procedure or a diagnosis of chronic CHF with new signs or symptoms within the previous 30 days. These symptoms include orthopnea, paroxysmal nocturnal dyspnea, exercise intolerance, elevated jugular venous pressure, cardiomegaly, or pulmonary vascular engorgement.

In the determination of functional status, the best functional status within the last 30 days before the fracture was taken into consideration. Independent functional status is defined as no requirement for assistance in daily activities such as feeding, mobilisation, bathroom needs and dressing-undressing.

The ability of the mFI-5 to predict postoperative complications within 30 days was measured in this study. Postoperative complications were defined as re-admission to hospital, surgical site infection, life-threatening medical complication, and mortality. The Clavien Dindo classification system was used in the determination of life-threatening complications.^[15,17] According to this system, conditions evaluated as Clavien-Dindo grade 4 included the need for intensive care, myocardial infarctus, pulmonary embolism, the need for postoperative dialysis, and the need for re-intubation and prolonged ventilation.^[19]

Data Analyses

Data obtained in the study were analyzed statistically using SPSS vn. 24 software (IBM Corp., Armonk, NY, USA). Frequencies of baseline characteristics, comorbid conditions, and outcomes were calculated and compared using the χ^2 test or Student's t-test for categorical or continuous variables, respectively. Multivariate logistic regression models were then used to assess the predictive value of the mFI-5 in all patients. Alpha was set at 0.05 and 95% confidence intervals (CIs) were reported.

RESULTS

A total of 105 eligible patients were identified who were treated between 2015 and 2020. Of these, 11 patients were excluded from the analysis: follow-up data were not available after discharge for seven patients, the preoperative and postoperative radiographs were not available for 2, the ASA grade was not known for 1, and comorbidity data were not available for 1. Thus, evaluation was made of 94 patients, of which 21 were treated conservatively and 73 were treated surgically.

The demographic data of the patients, including age, gender, ASA grade, fracture type, length of stay in hospital, and operating time are shown in Table 1.

A statistically significant relationship was determined between the hospital re-admission rate and the mFI-5 score ($p=0.038$, Odds Ratio [OR]: 3.4, 95% CI: 1.070–10.809). Wound site infection was determined to be statistically significant in mFI-5 regression analysis ($p=0.044$, OR: 2.86, 95% CI: 1.026–7.970). Life-threatening medical complications were determined to be statistically significant in mFI-5 regression analysis

Table 1. Patient demographics

	N	Mean	SD
N	94		
Surgical treatment	73		
Conservative treatment	21		
Age (years)		74.54	5.365
Sex			
Female	36		
Male	58		
Body mass index	26.98	4.86	
ASA grade			
1	14		
2	41		
3	15		
4	3		
Hospital stay (days)		3.91	3.17
Operation time (min)		53.26	34.82
Fracture type			
Weber A	5		
Weber B	69		
Weber C	20		
Open fracture	3		

SD: Standard deviation; ASA: American Society of Anesthesiologist

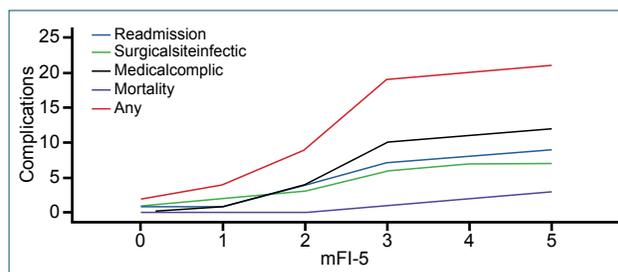


Figure 1. The rates of all complication types increased as the mFI-5 score increased. mFI-5: 5-factor modified Frailty Index.

($p=0.004$, OR: 5.162, 95% CI: 1.684–15.818). No statistically significant relationship was determined between mortality and the mFI-5 ($p=0.998$). When all the complications were examined together, the presence or not of any one complication was found to be statistically significantly correlated with the mFI-5 ($p=0.009$, OR: 2.76, 95% CI: 1.285–5.783).

The presence of any complication was not found to be statistically significantly correlated with length of hospital stay, operating time, age, BMI, and ASA score ($p>0.05$) (Table 2). When the cumulative values of the complications were examined with the mFI-5, the predictive power of the mFI-5 was seen to be greatest when any complication was observed (Fig. 1).

DISCUSSION

To the best of our knowledge, this is the first study to have used the mFI-5 in geriatric ankle fractures. The most important finding of the study was that the mFI-5 can be used as an effective predictive tool in the determination of re-admission, surgical site infection, life-threatening complications, and the occurrence of any complication.

Studies in literature show variability in the rates of complications occurring after geriatric ankle fracture treatment. This rate was reported as 59% by Beauchamp et al.^[20] and 15.96% in another study.^[21] In the current study, the total complication rate was found to be 22%. The difference between the reported rates can be attributed to the lack of a common,

Table 2. Results of the logistic regression analysis of any complication and other factors

Any complication	Significant	Odds ratio	95% Confidence interval	
			Lower Bound	Upper Bound
5-factor modified Frailty Index	0.008	2.755	1.302	5.830
Hospital stay	0.462	0.895	0.666	1.203
Operation time	0.919	0.999	0.970	1.028
Age	0.506	1.050	0.908	1.215
American Society of Anesthesiologist	0.999	1.000	0.381	2.626
Body mass index	0.497	0.952	0.827	1.096

standardized predictive tool for use in geriatric ankle fractures. In a study by Aigner et al.,^[10] which examined the relationship between operating time and complication rates, the total complication rate was found to be 28.7%. In that study, a relationship was determined between operations lasting longer than 60 min and complication rates, but when the total operating times, both longer and shorter than 60 min, were examined no relationship was determined with complications, as in the current study. Simske et al.^[11] reported a total complication rate of 17% using STTGMA as the predictor tool. In the prediction of length of stay in hospital and the complication of re-admission, the STTGMA was found to be effective. In the current study, the mFI-5 was determined to be more effective than ASA grade, length of hospital stay, age, and operating time in the determination of total complications. This finding was seen to be similar to that of studies where mFI-5 was used on other patient populations without geriatric ankle fracture.^[15-17]

The mFI-5, which is a modified form of the 11-factor Frailty Index was defined by Subramaniam et al.^[14] with the examination of the status of five comorbidities. It has fewer variables than other risk indexes such as the Elixhauser Comorbidity Method (30 factors) and the Charlson Comorbidity Index (19 variables), and the simplicity of the index provides a practical clinical tool for the accurate prediction of high-risk patients. Therefore, the mFI-5 started to be used in the prediction of complications in the treatment process of many orthopaedic disorders involving the geriatric population, such as patients applied with rotator cuff repair, hip and knee arthroplasty, and those with radius distal-end fractures and hip fractures, and the effects have been proven and reported in recent literature.^[15-18]

There are few studies that have reported the costs associated with the surgical treatment of ankle fractures. In an analysis of operated ankle fractures by McDonald et al.,^[22] the treatment costs of this patient population were reported to vary between 12,000 and 54,000 USD. When the increasing elderly population in Turkey, as throughout the world, is taken into consideration, it can be seen to be necessary for doctors and hospital systems to be able to quickly and simply identify high-risk patients to optimize the changeable risk factors. When examined in this respect, the current and recent studies have shown that the mFI-5 is a useful predictive tool.

There were some limitations to this study, primarily that because it was a single-center study the number of patients was lower compared to other studies. When mortality was examined, as only three patients developed mortality, no significant evaluation result could be obtained. Therefore, the effect of mFI-5 on the prediction of the complication of mortality could not be tested. Another limiting factor was that it was not possible to evaluate the complication known as adverse discharge when a patient cannot be discharged to their own home and is transferred to a nursing home. This

has been evaluated in similar studies but was not feasible in this study. Such a procedure is not a part of the healthcare system in Turkey, but in its place, home care by healthcare personnel has been developed.

Conclusion

The mFI-5 is a sensitive tool for the prediction of complications which may develop following geriatric ankle fracture. The five comorbidities which constitute the mFI-5 are easily obtained from the patient anamnesis, and this renders it a practical clinical tool to identify high-risk patients, determine the preoperative risks, and improve the healthcare service.

Ethics Committee Approval: This study was approved by the Aksaray University Rectorate Human Research Ethics Committee (Date: 22.02.2021, Decision No: 2021/01-34).

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Conflict of Interest: None declared.

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ORJİNAL ÇALIŞMA - ÖZ

5 faktörlü modifiye kırılmalık indeksi, geriatrik ayak bileği kırıklarında prognostik bir gösterge midir?

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AMAÇ: Frailty endeksinin son versiyonu olan 5 faktörlü modifiye Frailty İndeks, hastaların komorbidite durumlarını puanlayarak tedavi sonrası komplikasyon riskini hesaplayan bir araçtır. Çalışmamızda, mFI-5'in geriatrik ayak bileği kırıklı hastalarda komplikasyonları öngörmedeki etkinliğini değerlendirmeyi amaçladık.

GEREÇ VE YÖNTEM: 2015–2020 yılları arasında hastanemizde tedavi görmüş 65 yaş üzeri ayak bileği kırığı olan toplam 94 hasta incelendi. Weber tip A, B, C kırıklar çalışmaya dahil edildi. Her hasta için diyabetik durum, kronik obstrüktif akciğer hastalığı, konjestif kalp yetersizliği, ilaç gerektiren hipertansiyon ve fonksiyonel durumu sınırlandıran bağımsızlıktan oluşan komorbidite durumları için mFI-5 hesaplandı. Multivaryans lojistik regresyon modelleri, mFI-5 puanını olumsuz sonuçların bir öngörücüsü olarak değerlendirmek için kullanıldı.

BULGULAR: Yeniden yatış oranı, yara yeri enfeksiyonu, hayatı tehdit eden tıbbi komplikasyonlar ile herhangi bir komplikasyon olup olmama durumunda, mFI-5 in bu komplikasyonları ön görmede etkili olduğu gözlenmiştir ($p<0.05$). Herhangi bir komplikasyon olup olmama durumu ön görmede mFI-5 ile BMİ, ASA, Age, hastanede yatış süresi ve operasyon süresi kıyaslandığında mFI-5 in komplikasyonları öngörmede daha etkili bir araç olduğu gözlenmiştir ($p<0.05$, OR=2.726, %95 Confidence Interval=1.285–5.783).

TARTIŞMA: MFI-5, geriatrik ayak bileği kırıkları sonrası oluşabilecek komplikasyonları tahmin etmek için hassas bir araçtır. MFI-5'i oluşturan 5 komorbidite, hasta öyküsü aracılığıyla kolayca elde edilir, bu da onu yüksek riskli hastaları tanımlamak, ameliyat öncesi riskleri belirlemek ve sağlık hizmetini iyileştirmek için pratik bir klinik araç haline getirir.

Anahtar sözcükler: Ayak bileği kırıkları; Frailty index; komorbidite; komplikasyon.

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