

Prediction of a new fracture after a wrist fracture – a five year follow up

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Research article

Keywords: Accidental falls, postural balance, osteoporotic fracture

Posted Date: January 31st, 2020

DOI: <https://doi.org/10.21203/rs.2.22334/v1>

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Abstract

Background Falls and ensuing fractures are major challenges in our ageing population. The aim of this study was to study if clinical balance measures, function of the inner ear, self-rated health or fracture risk assessed by FRAX[®] could predict future admission to hospital because of a fracture among a group of older persons with previous wrist fracture.

Methods This was a longitudinal study with a 5-year follow-up. Searches in the local health authority's patient administrative system (PAS) were performed 5 years after inclusion and baseline measurements were taken. Information was extracted about whether participants had been treated for a fracture or hospitalized other reasons during the 5-year period. Persons, 50 years and above, with previous wrist fracture (n=83). Five different clinical balance measures was assessed, postural sway was assessed by means of a force plate, vestibular asymmetry was assessed with the head-shake test, self-rated health by EuroQol 5 Dimension visual analogue scale and risk of future fracture by the Fracture Risk Assessment Tool (FRAX[®]). Age and body mass index was also used in the risk analysis.

Results Age was associated with risk of future fracture, OR 1,06 (95% CI 1,01-1,12). The ability to stand on one leg with eyes open correlated significantly with future fracture (p=0.011) and so did FRAX^{osteo}, however on the limits of significance (p=0.052).

Conclusion This follow-up study showed that the one-leg standing time-test was a stronger predictor for future fracture within five-years after a wrist fracture than FRAX not including a measure of balance.

Introduction

The increase of the ageing population around the world is a great challenge to both health care and the society, since also diseases and events related to age increases [1]. Falls and ensuing fractures are major challenges that also leads to individual suffering and also death [2]. The need for identifying individuals at high risk for falls and thereby fractures is evident.

Several screening tools for increased risk for fractures are available, such as the Fracture Risk Assessment Tool (FRAX[®]) algorithm, developed by Sheffield University and the World Health Organization [3]. FRAX[®] includes variables such as previous fracture, smoking and the use of corticosteroids. Assessment of balance is seldom included in screening tools for risk for fracture but widely used in clinical assessment of risk of falls and fractures. There is a correlation between clinical balance measures and FRAX[®], especially between the balance measure standing one leg eyes closed (SOLEC) and FRAX[®] [4]. Reduced inner ear function has also shown to be significant for predicting future falls [5] and is over-represented among individuals with wrist fracture as well as among persons with hip-fracture [6, 7]. Hence, in order to identify persons with high risk of a future fracture, these variables can be helpful. However, in what way they combination of them can be of predictive value in individuals with a possible increased risk for fractures is not yet studied.

The aim of this study was therefore to study if clinical balance measures, function of the inner ear, self-rated health or fracture risk assessed by FRAX® could predict future admission to hospital because of a fracture among a group of older persons with previous wrist fracture.

Methods

A 5-year follow-up was performed on a group of persons, 50 years and above, with previous wrist fracture, from a previous study about vestibular rehabilitation for persons with wrist fracture [8].

Participants

In total, 83 patients were included in the study, 79 women and 4 men, 54–79 years old ($SD \pm 9$), all had a wrist fracture. The skew of gender distribution is in line with the difference in frequency of wrist fractures between males and females [9].

Measures

Balance was assessed with five clinical balance measures and in terms of postural sway. The clinical balance measures were:

Tandem standing with open and closed eyes, where time up to 30 seconds was measured [10–12]. Three attempts were allowed and the best attempt was used.

Standing one leg with eyes open (SOLEO) and with eyes closed (SOLEC) [11, 13, 14]. Time, up to 30 seconds was measured and three attempts were allowed, the best attempt used.

Walking in the modified figure of eight, where steps outside the line was counted [15].

Five times sit-to stand test, where the participants sit on a chair, stand up and sit down five times as fast as possible. Time in seconds is measured [16, 17].

Postural sway was assessed by a force plate, which measures the mean value for in which speed (mm/s) that center of pressure is changed in the medio-lateral and in the antero-posterior direction in quiet standing. Measures of postural sway on a force plate had shown to have good test-retest reliability as well as good intrasession reliability [18, 19].

Function of the inner ear was measured by the head-shake test, using Video-Frenzl goggles. The test indicates vestibular asymmetry when three or more saccades are visible [7].

Self-rated health was measured with the visual analogue scale included in the generic instrument EQ5D [20]. The participant were asked to rate their health on a vertical scale, where 100 was the best imaginable state of health and 0 was the worst.

To assess the risk for future fractures, the FRAX® tool was used. FRAX calculate the 10-year probability of hip fracture and the 10-year probability of a osteoporotic fracture. A value of < 5 is considered as low fracture risk, value between ≥ 5 and < 7.5 is considered as intermediate risk and value of ≥ 7.5 is considered as high risk [21].

Procedure

The participants were first informed about the study and then invited to participate at the time of visiting the orthopedic clinic in Malmö for removing the cast after a wrist fracture. Those who wanted to participate in the study was given an appointment to physiotherapist in primary health care in Malmö, were informed and written consent was obtained and assessments performed. Data were collected between December 2008 and November 2012. More details about the participants and recruitment has been described previously [4, 8].

Searches in the local health authority's patient administrative system (PAS) were performed 5 years after inclusion and baseline measurements were taken. Information was extracted about whether participants had been treated for a fracture or hospitalized for any other reason during the 5-year period.

Statistics

Analysis were performed using SPSS and an online calculator for chi square [<https://www.socscistatistics.com/tests/chisquare/>]. Binary outcome of fracture was analysed with multivariate logistic regression. The outcome variable was fracture of any kind (yes vs. no) and the independent variables were age and BMI. To analyse differences between groups, a chi-square test was used for fracture vs. positive or negative head shake test. Two-sided t-test was used to analyse differences in mean values of SOLEO and SOLEC. Because of the characteristics of the non-normal distribution of FRAX, we employed a Mann-Whitney test.

Ethics

All participants gave their informed consent to participate in the original study and both the original study and this follow up has been approved by the Regional Ethical Review Board in Lund (dnr 585/2008 and 2017/595).

Results

Characteristics of participants are given in Table 1. As 90% of fractures were osteoporotic, the results are presented for all fractures.

There was no correlation between BMI and fracture. Age (years) was correlated to the risk of further fracture, OR 1,06 (95% CI 1,01–1,12).

There was no difference in the outcome of fracture for the headshake test.

SOLEO was associated with future fracture, $p = 0.011$, Fig. 1

FRAXosteo was associated with future fracture, on the margins of significance, $p = 0,052$.

Table 1
Characteristics of the participants and correlations between fracture and other variables.

	All at baseline	No fracture during follow up	Fracture during follow up	Tests
n	83	42	41	n.s.
Age in years mean (SD)	71.7 (8.9)	69.6 (9.5)	73.9 (13.7)	OR 1.06 (95% CI 1.01–1.12).
Women (%)	94	93	95	n.s.
Positive headshake (%)	79	81	78	n.s.
FRAXhip mean (SD)	11.0 (8.0)	9.6 (6.8)	12.4 (8.9)	n.s.
FRAXosteo mean (SD)	24.7 (12.6)	22.1 (10.9)	27.5 (13.7)	0.052
SOLEO mean (SD)	17.7 (11.1)	20.7 (11.2)	14.6 (10.3)	0.011
SOLEC mean (SD)	4.5 (5.5)	5.5 (6.2)	3.5 (4.5)	n.s.

Discussion

This five-year follow-up study showed that age and poor ability to stand on one leg with eyes open was associated with future fracture. The fracture probability index FRAXosteo was also associated with future fracture, but on the limit of significance.

Impaired balance has a strong correlation to falls [22] but which balance measure to use to predict falls has been difficult to identify, since keeping our balance is a complex task and thus measuring balance is as well. There is a diversity of clinical balance measures targeting different aspects of balance among different groups of individuals. Our study supports other findings of SOLEO to be an appropriate measure for the prediction of future falls among older persons with a known risk for falls [23]. FRAX and SOLEO complement each other, hence the combination of FRAX and SOLEO can be valuable [4].

Vestibular asymmetry has in previous studies shown to be common among older persons with hip-fractures and with wrist-fractures [6, 24] and has also shown to predict falls among older persons with multisensory dizziness [5]. Therefore, the lack of correlation between future fracture and vestibular asymmetry in this study is surprising, especially since vestibular asymmetry and balance deficits correlate [8]. Hence, more research is needed to deepen the knowledge.

As suspected, was age associated with future fracture, which has been shown in a number of studies [25, 26].

Data concerning hospitalization for fracture was retrieved through the patient administrative system (PAS), which is used for resource allocation and has been checked for registrations errors by professional experts. Therefore, the system is rated as highly reliable.

Besides the variables evaluated in this study, other factors that can influence falls and fractures. One such variable is the use of psychotropic drugs [27, 28], which we had no possibility to include in our analysis. To confirm the usefulness of SOLEO as predictor of fracture, future studies on sensitivity and specificity is demanded, with the suggested cut-off value of 14 seconds.

Conclusion

This follow-up study showed that a balance test was a stronger predictor for a future fracture within five-years after a wrist fracture than FRAX not including a measure of balance.

Key Points

One single balance measure might be sufficient for screening for fall risk among older persons with previous fall-related wrist fracture.

One leg eyes open is a stronger predictor for future fracture than FRAX.

Future studies is needed for testing the sensitivity and specificity of SOLEO as a predictor of future fracture. Based on the findings in this study, a cut-off value of 14 seconds is suggested.

Declarations

Ethical approval and consent to participate: All participants gave their informed consent to participate in the original study and both the original study and this follow up has been approved by the Regional Ethical Review Board in Lund (dnr 585/2008 and 2017/595).

Consent of publication: Not applicable

Availability of data and materials: The datasets generated and/or analysed during the current study are not publicly available due GDPR and due to the Swedish ethical law but are available from the corresponding author on reasonable request.

Competing interest: The authors declare that they have no competing interests.

Funding: The study had no external funding.

Authors contribution:

EEH participated in the planning of the study, in writing ethical application, in analysing data and in writing the manuscript.

LED participated in the planning of the study and in drafting of the manuscript.

MM participated in planning of the study, in interpreting the measurements on vestibular function and in drafting of the manuscript.

AB participated in the planning of the study, and had main responsibility for statistical analyses as well as retracting data from in the local health authority's patient administrative system. AB also participated in drafting of the manuscript.

Acknowledgements: None

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Figures

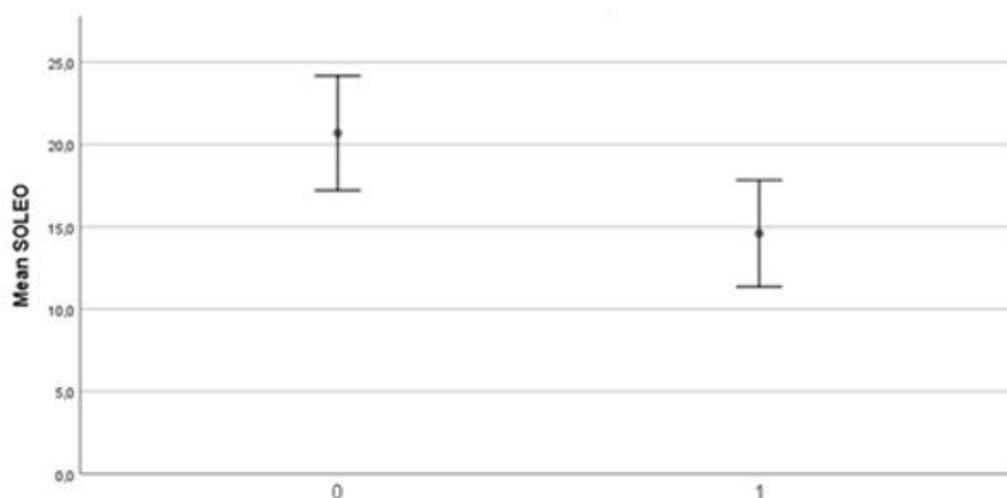


Figure 1

The association between mean value for standing one leg eyes open (SOLEO), in seconds and future fracture (0=no fracture, 1=fracture).