
Deep Learning Model Predicts Subsequent Short-term Hip Fractures



A study published in *Radiology* dwells into the efficacy of a sophisticated deep learning model in accurately predicting short-term subsequent fractures in patients who have recently experienced a hip fracture. This innovative approach utilises digitally reconstructed radiographs obtained from three-dimensional hip CT scans, demonstrating remarkable performance in identifying individuals at high risk of experiencing another fracture within five years.

Filling a gap: Addressing Short-Term Fracture Risks

This novel research addresses a critical gap in current fracture risk assessment methodologies. Despite the well-established understanding that patients face the greatest risk of subsequent fractures in the immediate aftermath of an initial fracture, existing predictive models have primarily focused on long-term risks, overlooking the crucial short-term window. The retrospective study, conducted by Yisak Kim, encompassed adult patients who had undergone three-dimensional hip CT scans following a fracture between January 2004 and December 2020. Leveraging cutting-edge technology, two-dimensional frontal, lateral, and axial digitally reconstructed radiographs were meticulously generated and amalgamated to form an ensemble model.

Engine of Innovation: DenseNet Modules Drive Predictive Accuracy

At the core of this groundbreaking approach lay DenseNet modules, instrumental in computing the probability of fracture recurrence based on extracted image features. The model further furnished fracture-free probability plots, enhancing its predictive accuracy and clinical utility. Performance evaluation of the model was conducted using established metrics such as the C index and area under the receiver operating characteristic curve (AUC), with comparisons drawn against existing models through rigorous statistical analyses. The comprehensive dataset comprised 1,012 patients in the training and validation set, with an average age of 74.5 years, among whom 706 were female and 113 experienced subsequent fractures within the stipulated timeframe. The test set, consisting of 468 patients with an average age of 75.9 years, included 335 females and 22 individuals who sustained subsequent fractures. Notably, in the test set, the ensemble model exhibited a superior C index of 0.73 for predicting subsequent fractures compared to other image-based models, with C indices ranging from 0.59 to 0.70 ($P < .001$ to $< .05$).

Charting Success: Impressive AUCs Validate Model Superiority

Furthermore, the ensemble model demonstrated commendable AUCs of 0.74, 0.74, and 0.73 at 2-, 3-, and 5-year follow-ups, respectively, surpassing the performance of most alternative image-based models. Specifically, at the 2-year mark, AUCs ranged from 0.57 to 0.71 for five of six models ($P < .001$ to $< .05$), while at 3 years, AUCs ranged from 0.55 to 0.72 for four of six models ($P < .001$ to $< .05$). Impressively, the AUCs achieved by the ensemble model also outperformed those of a clinical model incorporating known risk factors, with respective AUCs of 0.58, 0.64, and 0.70 at 2-, 3-, and 5-year intervals ($P < .001$ for all).

Deep Learning Reshapes Fracture Risk Assessment

This pioneering study underscores the potential of an ensemble deep learning model utilising digitally reconstructed radiographs from hip CT scans to accurately predict short-term subsequent fractures in patients recovering from recent hip fractures. With its robust performance metrics and superior predictive capabilities compared to existing models, this innovative approach holds immense promise in revolutionising fracture risk assessment and enhancing clinical decision-making for improved patient outcomes.

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