

Artificial intelligence for ESWT in calcific tendinitis of the shoulders

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Introduction

Machine learning is a promising technique, which has been applied in healthcare for decades in investigation of the properties of clinical datasets and to predict the outcomes of disease and treatment. Strong evidence supports that extracorporeal shockwave therapy (ESWT) is effective in treating calcifying shoulder tendinitis. However, incomplete resorption and dissatisfactory results were still reported in around 44% and 34% of cases. To date, no literature focused on deriving a data-driven-based treatment algorithm for the treatment of calcific shoulder tendinitis by ESWT. The purpose of this presentation is to identify the ideal machine learning technique for the prediction of ESWT-induced shoulder calcification resorption and the most accurate algorithm for use in the clinical setting.

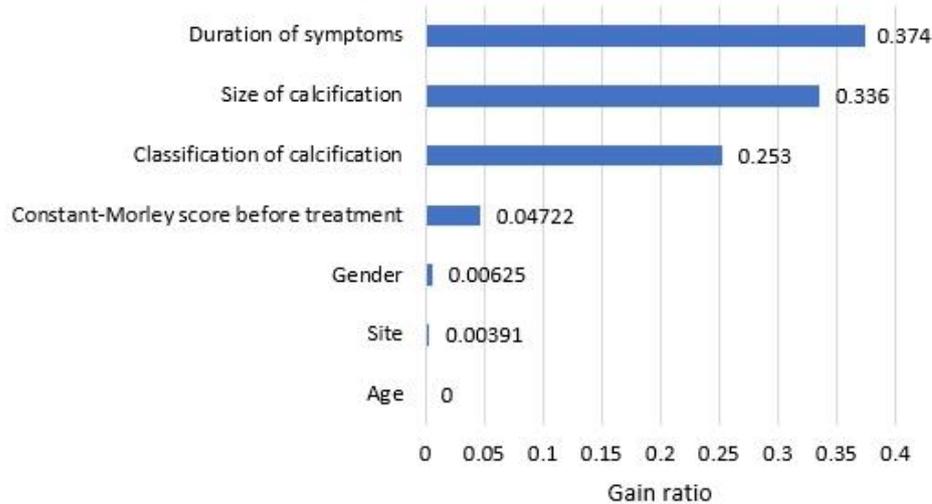
Material & Method

From 1998 to 2020, patients with painful calcified shoulder tendinitis were treated using ESWT. The analyzed attributes were divided into radiographic (size and classification of calcification) and clinical factors (gender, age, site, duration of symptoms, and Constant-Murley score (CMS) before treatment). Patients were classified as having achieved complete resorption (CR) or incomplete resorption (ICR). One year after ESWT, clinical outcomes including the CMS and Reported satisfactory rate were evaluated. The machine learning technique was applied via the Weka 3.8.2 program, and multilayer perceptron (neural network), naive Bayes, sequential minimal optimization algorithm (SMO), logistic and J48 decision tree classifiers were selected as the candidate methods.

Results

Two hundred and forty-eight patients (CR:ICR = 142:106) with calcific shoulder tendinitis were enrolled in this study. Complete resorption group revealed superiority in terms of the CMS (CR: ICR = 89.0 ± 16.4 : 67.9 ± 19.3 , $p < 0.001$). Duration of symptoms yielded the highest gain ratio (0.374), followed by size (0.336) and classification (0.253) (Figure 1). The accuracy of three input attributes was 89.5% by 10-fold cross validation, indicating a satisfactory accuracy using the J48 decision tree method.

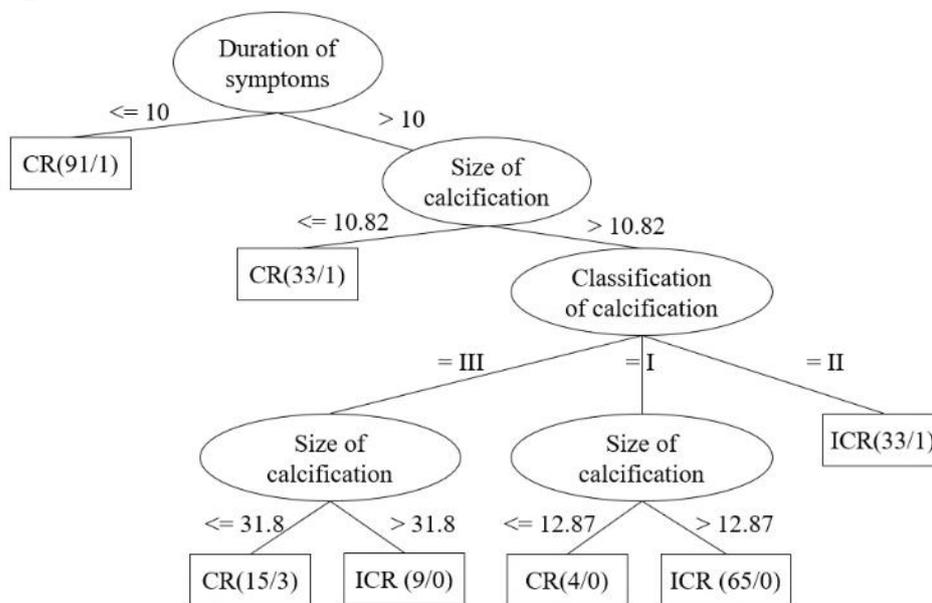
Figure 1: Flowchart of the study



Discussion

J48 decision tree method indicated that symptoms experienced for fewer than 10 months could be the most positive indicator of calcification resorption, followed by a size of 10.82 mm or smaller (Figure 2). The J48 decision tree method had the highest precision and accuracy in the prediction of shoulder calcification resorption by ESWT. A duration of symptoms shorter than 10 months or a size smaller than 10.82 mm represented the ideal clinical condition. With the application of machine learning, the treatment algorithm and indication could be revised in a precision and modern way.

Figure 2: J48 decision tree architecture.



Technology: Focused Shockwave, Machine learning.

Device and Manufacturer: OssaTron (High Medical Technology, Lengwil, Switzerland; now SANUWAVE, Alpharetta, GA) or Orthospec equipment (Medispec Ltd., Yehud, Israel).

COI: No conflict of interest.