Development of Talus Implant based on Artificial Neural Network prediction of Talus Morphological Parameters

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Abstract

The design philosophies of current talus implant focus too much on mechanical simplicity and usually based on certain population which tends to ignore the bony geometry difference between populations. Thus, the talus implant for particular population was developed based on artificial neural network (ANN) prediction of talus morphometrics. By using Finite Element Method (FEM), numerical models that include mainly the talus bone and the talus implants are created to compare the performance of newly develop talus implant with the three different kind of current talus implant designs. The study demonstrates that not all current talus implant are perfect match for this particular population. While, the ANN method showed a greater capacity of prediction regarding on the low percentage of error and high correlative values with the measurements obtained through Computer Tomographic (CT) scan. ANN is highly accurate predictive methods and has the potential to be used as assisting tools in designing talus implant. For FEM results, only BOX and newly develop talus implant exceeded the contact stress recommended for the superior articular surface compared to the others. The results also showed that the stress increased near the resected surface. Thus, it is agreed that excessive bone resection may not support the force at the ankle which consequently may contribute to early loosening and subsidence of the talus implant. It is concluded that the excessive bone resection can be avoided by perfectly match talus implant which only can be achieved by designing talus implant for a particular population.

Keywords: Talus Morphometric; Artificial Neural Network; Finite Element Method.