Comparison of endovascular device sizing based on conventional two-dimensional measurements and numerical simulation software

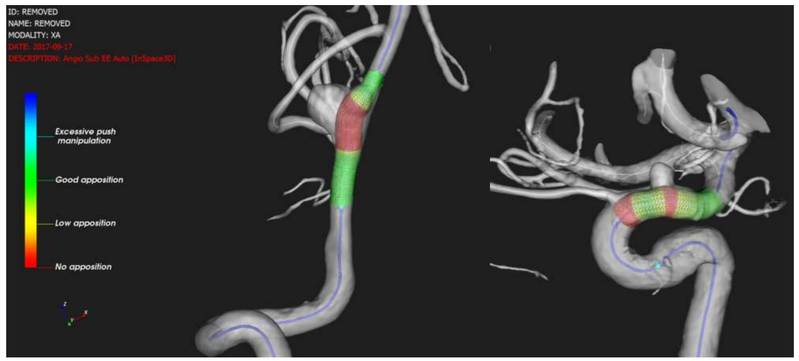
J.M. Ospel[1], D. Zumofen[2], G. Gascou[3], V. Costalat[3], K.A. Blackham[1]
[1] Department of Neuroradiology and [2]Neurosurgery, University Hospital of Basel, Switzerland
[3] Department of Neuroradiology, Hôpital Gui de Chauliac CHU, Montpellier, France

PURPOSE

To evaluate whether use of a computer based simulation model results in selection of different Pipeline embolization device (PED) dimensions compared to conventional PED sizing.

INTRODUCTION

Proper sizing of intraarterial devices for aneurysm treatment is crucial. The behavior of an intraarterial device (wall apposition and foreshortening) depends on several factors with final device dimensions and landing zones being poorly predictable. A numerical computer-based simulation model (Sim&Cure; Grabels, France) has be shown to provide accurate and fast anticipation of endovascular distention, wall apposition and final device length based on 3D rotational angiography DICOM data (fig. 1).



MATERIALS & METHODS

In a retrospective multi-center cohort study of 41 cases undergoing aneurysm treatment using the Pipeline Embolization Device (PED), device dimensions selected by four experienced neurointerventionalists based on manual 2D measurements taken from rotational angiography were compared to PED dimensions calculated by the simulation model. Agreement between the different methods was evaluated with Cohen's Kappa.

RESULTS

Software based measurements resulted in different device dimension suggestions in 92.7% (38/41 cases). In 56% (23/41), a shorter length was suggested by the algorithm, in 20% (8/41) a longer length and in 24% (10/41) the same length, whereas a shorter diameter was suggested in 37% (15/41), a longer diameter in 31.5 % (13/41) and the same diameter in 31.5 % (13/41). Agreement between conventional and computer based measurements was low (Cohen's K = 0.125 for length; K = 0.239 for diameter, p< 0.05, fig.2).

Fig. 1 (left): Preimplantational PED simulation. Green color indicates proper wall apposition, whereas yellow and red color implies suboptimal and poor appostiion.

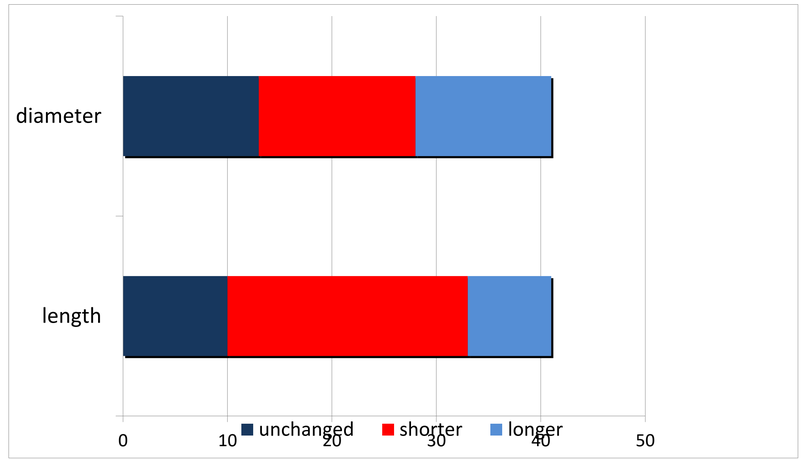


Fig. 2 (above): Change in PED dimensions due to software based calculation. In the majority of cases, either a shorter (red) or longer (light blue) length/diameter was suggested by the software (n = 41).

CONCLUSIONS

The low agreement between physician's choice and software based recommendations confirms that the choice of proper device dimensions is challenging. The software based solution potentially allows a decrease in procedure time and cost. Furthermore, it may remove uncertainty related to proper PED dimensions by accelerating the neuro-interventionalist's learning curve and confidence. Further evaluation of the simulation and subsequent translation into clinical practice is desirable.