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Development of Visceral Fat Simulator using Abdominal CT images

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***Abstract*— We developed a visceral fat simulator that generates and displays the shape of visceral fat before and after weight change by analyzing abdominal CT images.**

***Clinical Relevance*— We determined that this simulator can support effective health guidance for metabolic syndrome focusing on visceral fat.**

I. INTRODUCTION

The Japanese government provides health guidance for metabolic syndrome to prevent chronic diseases, mainly weight loss instruction to reduce visceral fat. When health guidance recipients undergo a visceral fat measurement test by X-ray CT, they are shown the state of their visceral fat accumulation and are motivated to lose weight [1]. However, it is difficult to easily measure visceral fat because an X-ray CT scanner is large and expensive. Therefore, we developed a visceral fat simulator that simulates the shape of visceral fat before and after weight change by analyzing abdominal CT images.

II. METHODS

Figure 1 (a) shows the changed shape of visceral fat before and after weight loss. The solid line marks before weight loss, and the broken line marks after weight loss. Figure 1 (a) shows the visceral fat shape changed more on the front of the body than on the sides of the body, and it is unchanged at the point of contact with the erector spinae.

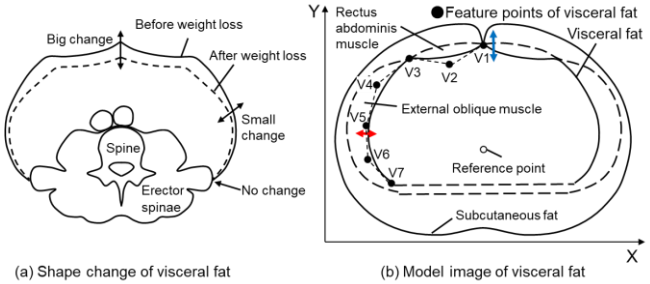

Figure 1. Model image of how visceral fat changes shape.

The visceral fat model image shown in Figure 1 (b) was created to reflect the characteristics of the changed shape of visceral fat. We propose a method of deforming the visceral fat shape using warping [2] by setting seven feature points V1 to V7 and a reference point in the model image. We estimate how much the feature points move by creating approximate expressions that show the relationship between the visceral fat area and how much the feature points move using abdominal CT images.

Using our method, we developed a prototype of the visceral fat simulator shown in Figure 2. We used data from 100 men who had abdominal CT scans for two consecutive years. Data were obtained according to the standards of internal review board on Research & Development Group, Hitachi, Ltd. Our prototype estimates the visceral fat area before and after weight changes and displays the visceral fat shape based on the estimated value. Figure 2 shows the current state on the left side and the state after weight changed on the right side. In addition, we can input how much weight changed with the bar at the bottom, and the image on the right changes based on how much weight has changed.

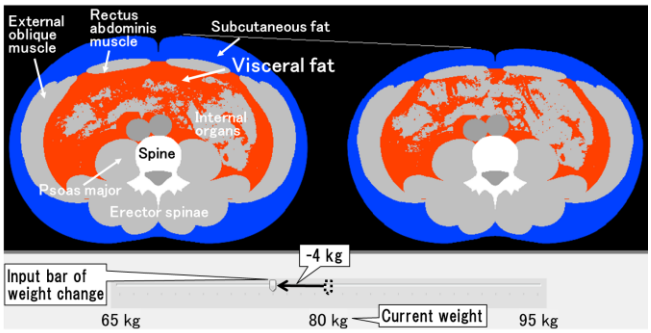

Figure 2. Prototype of visceral fat simulator.

III. RESULTS

We evaluated the accuracy of the visceral fat shape using the evaluation data of 100 men. We evaluated the error between the coordinates estimated by our method and the actual coordinates for feature point V1 on the front of the body and feature point V5 on the left side of the body. We determined that the average error is 1.21 cm and 0.83 cm, respectively, and can be estimated with an error of about 1 cm.

IV. DISCUSSION & CONCLUSION

We confirmed that this simulator can support health guidance that focuses on visceral fat by simulating realistic visceral fat shapes before and after weight changes.

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