

## Correspondence and Communications

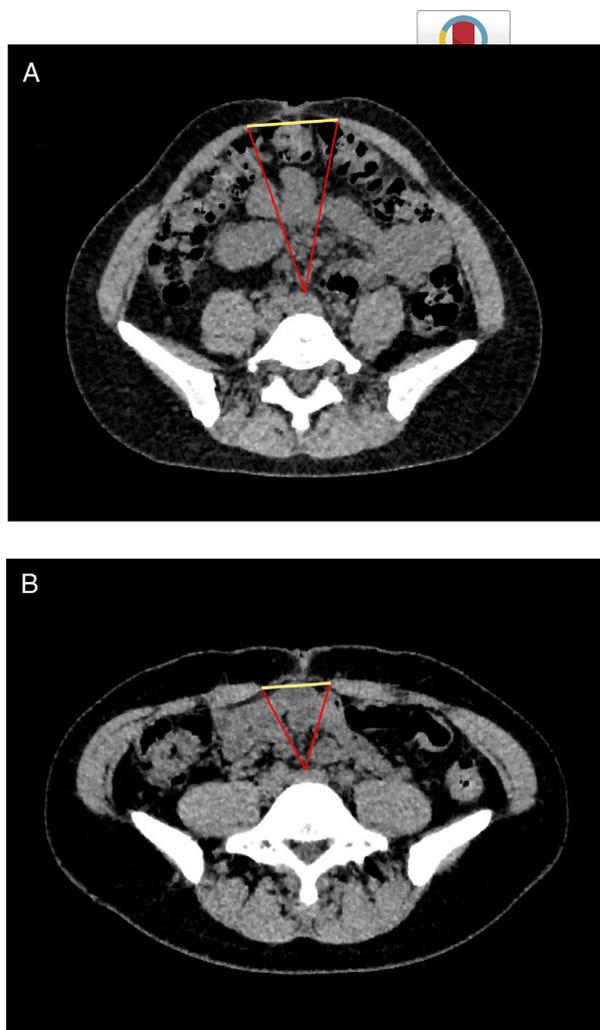
## Use of CT in a standing position for preoperative evaluation in abdominal incisional hernia: A pilot study

Dear Sir,

Abdominal incisional hernia is a complication after open abdominal surgery. Although many studies have investigated the treatment or risk factors of abdominal incisional hernia, there are few reports in the literature describing the diagnostic modalities to identify abdominal incisional hernia. The 'European Hernia Society guidelines on the closure of abdominal walls' recommends the use of ultrasound or computed tomography (CT) scan for diagnosis.<sup>1</sup> Although CT scans will likely provide the most sensitive and reproducible diagnosis of abdominal incisional hernia, multiple studies have reported considerable interobserver variability and a significant discrepancy between CT scan and physical examination.<sup>2</sup> This is mainly because the hernia may be apparent only when standing or straining. A visible bulge or lump under the skin is noticeable on physical examination with the patient in a standing position. However, these signs disappear when the patient is lying down, which is the conventional position for CT scans.

Recently, we developed an upright CT, which enables to obtain cross-sectional images of subjects in standing position.<sup>3</sup> We selected a 43-year-old female with an abdominal incisional hernia, and compared images from the conventional 320-detector row supine CT (Aquilion ONE; Toshiba Medical Systems, Otawara-shi, Japan) to images from the 320-detector row upright CT (TSX-401R, Canon Medical Systems, Otawara-shi, Japan). The component separation index was measured for each preoperative CT. This index utilizes the angle of diastasis of the rectus abdominis muscle with the vertex based at the aorta, and the separation distance of the rectus abdominis muscle to evaluate hernia severity.<sup>4</sup> This study received approval from the relevant institutional ethics review board, and informed consent was obtained from the patient.

A component separation index of 0.16 was calculated from the supine CT images. In contrast, the component separation index in the standing position was 0.06 (Figure 1). The axial and sagittal images show that the abdomen is flat in the supine position, but distinctly bulging in the standing position (Figure 1, extra). The distance between the



**Figure 1** Axial CT images in a supine (a) and a standing position (b). The component separation index (red angle) in a standing position is smaller than that in a supine position; however, the separation distance of the rectus abdominis muscle (yellow line) in a standing position was wider than in a supine position. Also, the abdominal circumference and shape are different in the two positions.

rectus abdominis muscle in the supine position was 3.8 mm, as compared to 4.9 mm in the standing position.

A variety of surgical techniques are used for the repair of incisional hernias. These techniques range from component separation to mesh repair.<sup>5,6</sup> The mesh repair technique is

recommended to prevent recurrence with large ventral hernias. The component separation index is useful in determining the optimal operative procedure.<sup>4</sup>

Normally, a smaller component separation index is associated with a less severe abdominal incisional hernia. In the present study, measurements on the upright CT revealed a larger distance between the rectus abdominis muscles, but a smaller component separation index than measurements taken in a supine position. This was due to the fact that greater abdominal bulging in the standing position increases the distance between the aorta and rectus abdominis muscle. Increased use of the upright CT will require a new evaluation for abdominal incisional hernia severity.

The diagnosis of abdominal incisional hernia is easy to evaluate with conventional supine CT images for cases of increased intraabdominal pressure with obesity; however, it is more difficult for slender patients. In contrast, standing CT images make hernia diagnosis easy in any body type. These findings were suggested to relate the considerable diagnosis by CT examination.

The standing CT modality is still in the research phase, and we were only able to include results from one case. However, we believe this modality will be useful for diagnosis, preoperative planning, and postoperative evaluation of abdominal incisional hernia, and may have much wider diagnostic impact in the future.

## Declaration of Competing Interest

Masahiro Jinzaki has received a grant from Canon Medical Systems. Canon Medical Systems has loaned the upright computed tomography machine to Keio University. However, Canon Medical Systems is not involved in the design and conduct of the study; in the collection, analysis, and interpretation of the data; and in the preparation, review, or approval of the manuscript. All other authors have no relationships with industry or other entities.

## Funding

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## Ethical approval

The present study was approved by the Institutional Review Board of Keio University School of Medicine (#20170134).

## Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:[10.1016/j.bjps.2019.09.018](https://doi.org/10.1016/j.bjps.2019.09.018).

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