Purpose: Current respiratory motion monitoring devices used for motion synchronization in radiotherapy provide only 1D respiratory signals over a specific region. Newer technology offers the possibility to monitor the entire patient skin 3D surface in real time. The main objective of this work was to study the correlation between external patient surface and internal anatomical landmarks.

Methods: Ten patients with full 4D-CT datasets were included. In addition, synchronized surfaces acquired by a Time of Flight (TOF) camera were acquired during these 4D-CT acquisitions. Two experts manually identified anatomical landmarks in the thoracic region in each of the 4D-CT volumes. These landmarks include tumour location as well as surrounding normal tissues. Finally, the correlation between the internal landmarks motion and external surface motion was calculated and evaluated for different regions (placement and size) of the patient's surface.

Results: The best correlation was observed between the motion of the central regions of the abdominal (0.8 ± 0.18) and the thoracic area (0.72 ± 0.12) and especially with internal landmarks such as the diaphragm and mediastinum structures, as well as the tumour location landmarks. The worse correlation was found for internal landmarks that are not significantly affected by the respiratory motion such as the apex or the sternum (0.2 ± 0.18).

Conclusions: Large correlation variability was observed when considering different patients' external surface regions of interest and internal anatomical landmarks. The positioning of current devices used for respiratory motion synchronization may reduce such correlation by averaging the motion over correlated and poorly correlated external regions. The potential of capturing in real-time the motion of the complete patient surface as well as choosing the surface area that best correlates with the internal motion will allow reducing such variability and associated errors in both respiratory motion synchronization and subsequent motion modeling processes.