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3D shape analysis of thigh muscles: people with Chronic Obstructive Pulmonary Disease versus healthy older adults.

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Rationale and objective. Muscle weakness and atrophy is well-recognized in people with chronic obstructive pulmonary disease (COPD), however, its regional distribution within a muscle has not been studied. The purpose of this study was to perform 3D shape analysis in order to detecting shape abnormalities of individual thigh muscles in people with COPD compared to healthy people.

Materials and methods. Twenty COPD patients and twenty healthy adults (55-79 years) underwent magnetic resonance imaging that provided 100 axial slices of the thigh. Slice by slice segmentation of individual knee extensor and flexor muscles was performed, and using specialized software, the 3D shape of each muscle was constructed. Eight shape descriptors were determined for each thigh muscle and regionally (for portions of the muscle).

Analysis. A two-tailed t-test with a modified Bonferroni correction was used to compare group differences.

Results. Global analysis showed differences between groups ($p < 0.01$) for vastus intermedius (5 descriptors), semimembranosus (4 descriptors), and rectus femoris (1 descriptor). Regional shape differences ($p < 0.01$) between groups were found for all knee extensors and semimembranosus. A support vector machine classifier provided 95% to 100% accuracy in differentiating healthy from COPD muscles,

Conclusion. We found that coincident with atrophy, muscle shape is altered; knee extensors were affected more so than knee flexors in COPD. Further research is required to explore the underlying mechanisms of muscle shape discrepancies in COPD. A better understanding of these regional differences will facilitate the design of more specific therapeutic interventions that address muscle weaknesses and imbalance.