

Morphometric analysis of the lumbar interfascial triangle in healthy subjects

Emmanuel LEON¹, Veronique FEIPEL^{1,2}, Afarine MADANI³, Benoit BEYER^{1,2}

¹Laboratoire d'Anatomie, Biomécanique et Organogénèse, Faculté de Médecine ULB, Belgium

²Laboratoire d'Anatomie Fonctionnelle, Faculté des Sciences de la Motricité, ULB, Belgium

³Musculoskeletal Radiology, Erasmus Hospital, Belgium

Email: emmanuel.leon@ulb.be

Summary

This study aims to quantify some morphological characteristics of the lumbar interfascial triangle (LIFT) based on age, sex, side, lumbar level, and subcutaneous fat in healthy subjects. Using an analysis of 43 CT scans, manual segmentation and 3D coordinate mapping via Amira software, we achieved precise LIFT localization and spatial analysis. This study is the first to assess LIFT morphological characterization depending on different factors. Findings reveal that LIFT ascends above the twelfth rib in nearly half of the cases, with significant influences of sex and side on its position and orientation. This suggests a potential redefinition of the lateral raphe at the thoracolumbar junction. Future research should involve larger cohorts, including subjects with low back pain, with advanced segmentation tools for a better understanding of the LIFT's clinical implications in thoracolumbar fascia (TLF) function.

Introduction

TLF could play a key role in lumbar stability considering mechanical load distribution [1]. Within its complex structure lies the LIFT, a cephalocaudally oriented, triangular space connecting the transversus abdominis tendon and the erector spinae fascia [2]. This triangle could facilitate medio-lateral force distribution between abdominal and spinal muscles [2]. To our knowledge, no precise morphometric analysis exists in literature. Investigating its geometry and positional influences could enhance our understanding of its contribution to lumbar stability, TLF function and its potential role in chronic low back pain.

Methods

Abdominal CT scans from 43 asymptomatic subjects (21 men, 22 women, aged 21-51) were analyzed with strict inclusion criteria. Using Amira software, 3D LIFT reconstructions were created by segmenting skeletal and fascial structures. 65 anatomical landmarks were placed on the skeleton and LIFTs on which we managed to create centroids to compare LIFTs positions, accounting for morphological variability. Variables such as triangle dimensions, subject characteristics, Subcutaneous Fat Index (SFI) [3], and vertebrae levels were analyzed using ANOVA for variables influences and correlation tests for variables relationships.

Results and Discussion

Mean values of LIFT position and lateral raphe orientation have been assessed. One example is given in Figure 1, showing the average orientation of lateral raphe in the lumbar region. The LIFT extended above the 12th rib in 44% of cases, occasionally reaching the 11th or 10th ribs, with significant positional variations based on sex, side, and SFI. Female participants show a more laterally ($p < 0,001$) and posteriorly ($p = 0,015$) oriented LIFT when we lower the spine compared to men. These results underscore the LIFT's anatomical variability and the influence of sex. The more lateral orientation in female may be explained by sexual dimorphism, as males typically have a narrower pelvis and wider thoracic cage [4], which might impact the biomechanical role of LIFT depending on sex. The findings support further exploration, particularly in patients with lumbar pathologies and with more precise segmentation techniques regarding LIFT volumes.

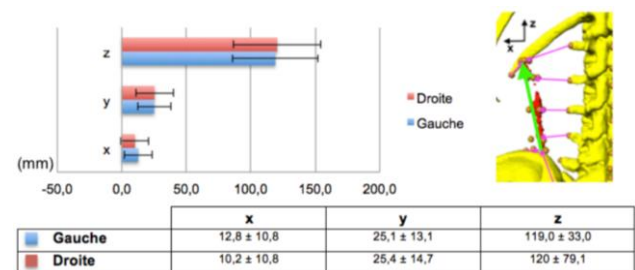


Figure 1: Average 3D orientation values of the vector linking the lowest LIFT to the highest. Red corresponds to the right side and blue to the left side.

Conclusions

This study examines the morphometry of the LIFT, revealing its variability in position, influenced by sex, laterality and SFI. Contrary to prior literature, triangles often extended above the 12th rib. Future research with larger cohorts and refined methods is needed to explore its biomechanical and functional roles within the thoracolumbar fascia and potentially assess its clinical implications in low back pain patients.

References

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