Kinematic analysis of infrapatellar fat pad dynamics during walking in patients with knee osteoarthritis

Miharu Sugimoto[1], Yosuke Ishii[1], Makoto Takahashi[1], Nobuo Adachi[2,3]

[1] Department of Biomechanics, Graduate School of Biomedical and Health Sciences, Hiroshima University, Hiroshima, Japan
[2] Department of Orthopaedic Surgery, Graduate School of Biomedical and Health Sciences, Hiroshima University, Hiroshima, Japan [3] Department of Sports Medical Center, Hiroshima University Hospital, Hiroshima, Hiroshima, Japan
Email: m-sugimoto@hiroshima-u.ac.jp

Summary

Infrapatellar fat pad (IFP) influences the progression of knee osteoarthritis (KOA). The purpose of this study was to reveal the factors relating to the morphological change of IFP during walking in patients with KOA. The amount of morphological change of IFP (ΔIFP) and kinematical parameters during walking were calculated, respectively, using a three-dimensional motion analysis system and ultrasonography. There was a positive correlation between ΔIFP and knee flexion angle during the swing phase.

Introduction

Infrapatellar fat pad (IFP) relates to the progression of knee osteoarthritis (KOA). The shape of IFP changes according to the knee movement [1]. However, patients with KOA often experience poor IFP shape change, which may lead to abnormal knee kinematics [2]. In our study, the amount of morphological change of IFP (ΔIFP) in patients with KOA during walking was smaller than in healthy subjects. The factors related to this remain unknown. The purpose of this study is to investigate the relationship between ΔIFP and kinematical parameters during walking.

Methods

Twenty-six patients with KOA were recruited (mean age, 60.3±9.8 years; BMI, 25.7±3.5kg/m^2; female, n=12). The participants were asked to walk 5 meters at a comfortable speed. Knee joint flexion angle and moment, and gait speed, were obtained using Nexus 2.14.0 (Vicon Motion Systems, Oxford, UK). Among several steps obtained, IFP and kinematical data of the second step were derived. To calculate knee joint flexion angle during the swing phase, the swing phase right before that was chosen. The maximum and the amount of range in flexion angle during the swing and stance phases were calculated, respectively. The maximum and impulse of knee joint flexion moment were calculated.

IFP data during stance phase was collected using ultrasonography with a new 3-11 MHz protype linear-array transducer (KONICA MINOLTA, Japan). The transducer was longitudinally attached to the center of the patellar tendon using belts. The morphological change of IFP was shown as the difference between the IFP thickness at initial contact and maximum in the stance phase.

Results and Discussion

Their severity and alignment were presented in **Table1**.

Table 1: The severity and alignment of the participants

KL (I, II, III, IV)		FTA (°)
TF	PF	
2, 11, 6, 3	9, 7, 5, 1	179.4±2.7

There was a significant correlation between ΔIFP and the maximum knee flexion angle during swing phase **(Figure 1)**.

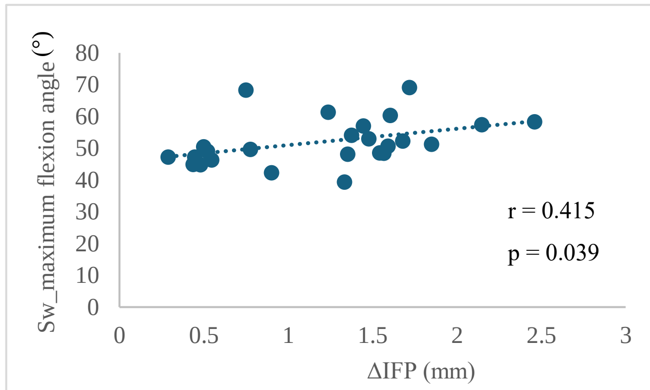

Figure 1: Correlation between ΔIFP and maximum knee flexion angle during swing phase

During knee flexion movement, IFP is normally required to be extruded proximally according to the shape change of the anterior knee compartment [1, 3]. However, in the case that the maximum knee flexion angle during the swing phase is small, proximal morphological changes in the anterior knee compartment and IFP during that phase may be less likely to occur. The morphological change of IFP during stance phase may not directly reflect the changes in knee flexion angle during this phase since it is affected by loading.

Conclusions

There was a positive correlation between the morphological change of IFP and the maximum knee flexion angle during the swing phase.

Acknowledgments

I would like to thank Kaoru Okada and Kazuya Takagi of KONICA MINOLTA, INK for their support of the established measurement using ultrasound.

References

[1] Dragoo JL et al. (2010). *Clin Biomech*, **25**: 433-437.

[2] Okita Yuriko et al. (2023). *J Phys Ther Sci*, **35**; 507-514.

[3] Michael B et al. (2004). *Knee Surg Sports Traumatol Arthrosc*, **13**: 135-141.