Three-Dimensional Gait Analysis Synchronized with Surface Electromyography after Total Knee Arthroplasty - Comparison between Prosthesis Designs for Normal Knee Function and Conventional Total Knee Arthroplasty -

Kojiro Hyodo\textsuperscript{1}, Akihiro Kanamori\textsuperscript{1}, Hideki Kadone\textsuperscript{2}, Masaya Kajiwara\textsuperscript{1}, Norihito Arai\textsuperscript{1} Yu Taniguchi\textsuperscript{3}, Tomokazu Yoshioka\textsuperscript{3}, Masashi Yamazaki\textsuperscript{1}

Department of Orthopaedic Surgery, Faculty of Medicine, University of Tsukuba, Tsukuba, Japan\textsuperscript{1}
Center for Innovative Medicine and Engineering, University of Tsukuba Hospital\textsuperscript{2}
Division of Regenerative Medicine for Musculoskeletal System, Faculty of Medicine, University of Tsukuba\textsuperscript{3}
Kojiro Hyodo, MD

• Part of co-presenter receives research founding from Smith & Nephew K K.
Introduction

Conventional TKA: non-anatomical surface
- Good long-term results
- Paradoxical motion
- Patient satisfaction ↓
  

Journey II: anatomical articular surface
(Smith & Nephew Inc., Memphis, TN)
- Good short-term results
  

- Normal-like kinematic patterns
  
• Poor results non-detectable by radiographic abnormalities

• Relation between quadriceps muscle weakness and poor results

→ Evaluation of muscle activation and kinematics

Objective

• Evaluation of the TKA prosthesis designed for normal knee using three-dimensional gait analysis synchronized with surface electromyogram

• Comparison between conventional TKA
Subjects

- Over-sixties, knee osteoarthritis, unilateral TKA, past 6 months

Prosthesis Designs for Normal Knee Journey Ⅱ: J-group (Smith & Nephew Inc., Memphis, TN): 3 cases

Conventional prosthesis Legion: L-group (Smith & Nephew Inc., Memphis, TN): 3 cases

<table>
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<th>Age (years)</th>
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<th>Duration of postoperative (Months)</th>
<th>Knee angle (degrees)</th>
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Methods

- Three-dimensional motion analyzer
  - Vicon Motion System Inc., Oxford, UK
  - 16 infrared cameras
  - Vicon Plug in gait model

- Wireless surface electrodes
  - Trigno Lab, Delsys, Inc., Boston, USA

Measurement of six muscles
- Vastus medialis (VM)
- Vastus lateralis (VL)
- Biceps femoris (BF)
- Rectus femoris (RF)
- Semitendinosus (ST)
- Gluteus medialis (GM)
Gait analysis

-10m walkway
-comfortable speed
-3 trials

Data analysis

- Knee angle (flexion-extension)
- %MVC of each muscles

Comparison between J-group and L-group
-Independent t-test
-P < 0.05
Both groups show double knee action. In J-group, knee flexion angle is high at initial stance phase.
Result: Surface electrodes

J-group showed greater Rectus femoris activity and lower hamstrings activity.
Discussion: Knee angle

J-group: Knee flexion angle is high at initial stance phase.

- After TKA, the knee flexion angle is low at initial stance phase.
- There was significant difference in knee flexion angle at initial stance phase between TKA group and control group.


L-group: Normal-like gait pattern

Operated side
Discussion: Surface electrodes

J-group: Rectus femoris activity ↑

Journey II positions femur at normal position compared with conventional TKA in the sagittal plane.

Journey II enhances the lever arm of the knee extensor mechanism, and this may have a positive effect on rectus femoris activity.
Discussion: Surface electrodes

L-group:
Rectus femoris activity ↓
Hamstrings activity ↑

Conventional TKA = ACL-deficient knee

- Quadriceps avoidance gait
  Decrease of quadriceps muscle activity during stance phase

- Greater hamstrings activity

Journey II: possibility for function of the ACL
Conclusions

• In Journey II, knee flexion angle is high at initial stance phase.

• Journey II may have a positive effect on rectus femoris activity, and possibility for function of the ACL.