

| | | PNF group (n=5) | Control group (n=5) | P |
|------------------|-----|------------------------|---------------------|-------------------|
| Speed (m/s) | Pre | 0.33±0.19 ^a | 0.30±0.15 | 0.04 [†] |
| | Pos | 0.42±0.22 | 0.32±0.13 | |
| | t | 0.02* | 0.02* | |
| Cycle (steps/m) | Pre | 0.62±0.09 | 0.58±0.12 | 0.44 |
| | Pos | 0.68±0.09 | 0.60±0.17 | |
| | t | 0.00* | 0.49 | |
| Step length (cm) | Pre | 31.40±16.47 | 29.80±17.81 | 0.13 |
| | Pos | 35.40±15.65 | 32.40±17.07 | |
| | t | 0.01* | 0.00* | |
| Non-operated | Pre | 25.60±15.69 | 26.00±15.25 | 0.00 [†] |
| | Pos | 31.60±15.14 | 28.00±13.84 | |
| | t | 0.00* | 0.06 | |
| Operated | Pre | 43.80±2.86 | 44.40±2.19 | 0.03 [†] |
| | Pos | 47.40±2.30 | 46.00±2.00 | |
| | t | 0.00* | 0.05 | |

^aMean±standard deviation, significant difference between pre and post intervention within the group (*p<0.05), significant difference between the change values among the groups ([†]p<0.05)

IV. DISCUSSION

This study was conducted to verify the effect of applying the PNF pattern to strengthen the hip extensor and hip extensors on the gait ability of patients with TKR, and to present a clinical method for rehabilitation of TKR patients.

The hip abductor muscle affects the regulation of pelvic movement during the stance phase during walking and is involved in hip joint stability [12]. Among the PNF pattern, the extension-abduction-internal rotation affects the stance phase during gait and is effective in improving spatiotemporal gait parameters [10]. In this study, when the PNF extension-abduction-internal rotation pattern was applied in the PNF group, all spatiotemporal gait parameters were improved after the intervention compared to the pre-intervention. The hip abductor muscle maintains and stabilizes trunk stability when walking. In particular, the transmission of force by the hip abductor muscle is an essential factor in controlling the movement of the pelvis relative to the femur during walking [13][14]. In other words, it is thought that the extension-abduction-internal rotation pattern conducted in this study effectively strengthens the hip abductor muscle, thereby improving the gait ability by playing the role of stabilizing the hip joint for the femur that is fixed during the stance phase.

In comparison between groups, the PNF group showed improved results in walking speed, step length on the non-operated side, and time on each foot on the operated side compared to the control group. In a study by Schache et al. [15], it was reported that strengthening exercise for the hip abductor muscle was effective in improving gait ability compared to the strengthening exercise for the knee extensor

muscle in total knee replacement patients. In this study, since muscle strength was strengthened for the hip abductor muscle compared with the control group in the PNF group only, it is thought that the result of improved gait ability was improved according to the improvement of physical function.

The PNF pattern applied in this study is an effective method to strengthen the muscles mobilized in the stance phase [16], and the lower extremity pattern extension-abduction-internal rotation also showed improved results of spatiotemporal gait parameters in the PNF group. Since the subjects of this study were subjects capable of performing the PNF lower limb pattern, it was possible to directly apply the pattern. However, in the case of the elderly with weak lower extremity muscle strength, there may be limitations in performing the correct posture [17][18]. To compensate for this, a method of indirectly activating the stance phase of the operated side by applying a flexion pattern to the opposite side to promote swing phase can be considered [10].

Since this study is based on subjects who visit a hospital and receive continuous management, there may be limitations in applying it to patients who are living daily. In addition, it is necessary to verify this as evaluation is only conducted after the intervention, and there is no evaluation on whether the future effect continues.

V. CONCLUSION

The purpose of this study was to verify the effect of PNF lower limb pattern application on gait ability in total knee replacement patients. The application of the PNF lower extremity pattern had an effect on the stance phase during walking by strengthening the hip abductor muscle, resulting in improved walking ability. Therefore, if you want to elicit an improved result of gait ability in patients with total knee replacement in the clinic, you should consider applying the PNF lower limb pattern.

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