Number: 11242

Title: Impact of hip joint stabilisation on functional outcome after internal hemipelvectomy and proximal femur resection using gait analysis

2. Author(s)

Toru Akiyama, Kazuo Saita, Koichi Ogura, Akira Kawai, Jungo Imanishi, Yasuo Yazawa and Toru Ogata

3. E-mail

Toru Akiyama: toruakiyama827@jichi.ac.jp, Kazuo Saita: saita@saitama-med.ac.jp,

Akira Kawai: akawai@ncc.go.jp, Jungo Imanishi: jungo.imanishi@gmail.com,

Yasuo Yazawa: yyazawa@saitama-med.ac.jp, Toru Ogata: ogata-toru@rehab.go.jp

Number: 11242

Background: Pelvic tumour resection is a challenging surgical procedure and can have a substantial functional, social, and psychological impact on the patient. Pelvic tumour resection with limb salvage, or internal hemipelvectomy, has emerged over the last 30 years, and is performed if a reasonably functioning extremity can be saved without compromising local control of the tumour. Moreover, the extensive resection of pelvic sarcomas often necessitates reconstruction to avoid severe functional disabilities as a result of loss of the acetabulum, an incomplete pelvic ring, and loss of the abductor musculature. Recently, the functional and psychological advantages of internal hemipelvectomy relative to external hemipelvectomy have been reported10. The reported functional outcomes of pelvic tumour resection measured by the MSTS score were >70% and identical to distal femur replacement. Of note, P1 resection or iliac wing resection resulted in an improvement of >90%11. However, these analyses were considered not to reflect the precise gait function. In particular, the MSTS scoring system has recently been questioned for not providing objective and quantitative information about functional recovery. The laboratory-based computer-assisted gait analysis represented the best method for objectively assessing the technical outcome of a procedure designed to improve gait. However, to date, little information has been available on the functional outcomes, such as gait parameters, following pelvic tumour resection. We hypothesised that hip joint stabilisation would provide a better functional outcome to not only patients of proximal femur resection but also to those of pelvic tumour resection. However, because few studies have examined in detail the gait function of patients following pelvic tumour resection, the factors affecting gait performance remain to be clarified.

Purposes: We aimed to assess objectively the short-term effect of a hip-stabilising supporter on gait ability following the resection of tumours located around the circumference of the pelvis using a laboratory-based computer-assisted gait analysis.

Patients and Methods: Three-dimensional gait analysis was performed to obtain cross-sectional data for 7 post-operative patients (mean age, 42.7; range, 20–61). Inclusion criteria were (1) wide resection with limb salvage for tumours around the pelvis, (2) no local recurrence, (3) no metastasis, and (4) completion of the treatment for a primary tumour at a minimum of 6 months prior to the gait analysis. The surgical procedures for these 7 patients were P1/4 internal hemipelvectomy (IH), P1/2/3 IH and proximal femur resection with prosthetic reconstruction. To assess hip joint stability, we instructed the subjects to walk at a preferred speed with or without a hip-stabilising supporter and subsequently compared the gait parameters between the 2 conditions.

Three-dimensional gait analyses were conducted with a motion analysis system, using 8 infrared cameras. Twenty-nine reflective markers were placed on the subject. The sampling rate of the system was set at 200 Hz for measuring the 3-dimensional positions of the markers. Eight force platforms were also situated at the midpoint of the walkway for obtaining the vertical and mediolateral components of the ground reaction force during the stance phase of the gait.

Results: At the baseline, the average walking speed was 0.75 m/sec (95%CI: 0.53 - 0.97). The patients who underwent proximal femur replacement showed a faster speed compared to the other subjects (the mean walking speed of proximal femur replacement; 1.19 m/sec, P1/4; 0.62 m/sec, P1/2/3; 0.54 m/sec). The intra-subject comparison demonstrated that the hip stabiliser increased the walking speed and improved both the temporal and spatial parameters. In this study, the cadence (number of steps per minute) and stride length [length of one (right + left) gait cycle] were selected as representative temporal and spatial factors, respectively. While the cadence of all the subjects increased when using the stabilisers, the stride length increased in all but 1 subject. The use of stabilisers had minimal effects on asymmetry between the healthy and affected limbs. Statistical analysis demonstrated a strong positive correlation between the MSTS score and both gait speed (base line and with hip stabiliser). MSTS score did not correlate with ground reaction force asymmetry and Stance time asymmetry.

Conclusions: Our findings suggest that further improvements in gait function following pelvic tumour resection is possible. Additional hip stabilisation could provide better gait function for patients who have undergone various types of pelvic tumour resection and proximal femur resection for the treatment of malignant musculoskeletal tumours. As a hip stabiliser, the abductor support elastic band is a simple and effective aid for promptly improving gait function in this type of patient.