



The relationship between morphometric parameters and Trendelenburg sign following the Hardinge incision

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Objectives: We evaluated the relationship between morphometric parameters such as height, weight, and body mass index with the development of the Trendelenburg gait following the Hardinge approach, which is one of the most commonly used approaches in total hip arthroplasty.

Methods: The study included 59 patients (43 women, 16 men; mean age 55 years; range 37 to 74 years) who underwent total hip arthroplasty via the Hardinge approach for primary coxarthrosis. The patients were examined postoperatively at 15 days, and at the end of the first and third months. The mean follow-up period was 24.3 months (range 12 to 37 months). The height, weight, and body mass index values of the patients with and without a positive Trendelenburg sign were compared.

Results: The Trendelenburg sign was positive in 19 patients (32.2%) following total hip arthroplasty with the Hardinge approach and persisted for a mean of 8.3 months (range 4-14 months). Patients with a positive Trendelenburg sign had a mean height of 157.4 cm (range 151 to 173 cm), mean weight of 82.5 kg (range 70 to 108 kg), and mean body mass index of 33.2 kg/m² (range 25.4 to 30.5 kg/m²). The corresponding figures in patients without a Trendelenburg sign were as follows: 166.3 cm (range 158 to 180 cm), 79.4 kg (range 72 to 94 kg), and 28.7 kg/m² (range 21.6 to 30.5 kg/m²). There was no significant difference between the two patient groups with respect to weight, but height and body mass index showed highly significant differences ($p < 0.0001$).

Conclusion: Based on our finding that patients having a significantly shorter height and greater body mass index sustained Trendelenburg positivity for quite a long time, we recommend that these two factors be taken into consideration in the preoperative evaluation of patients for total hip arthroplasty with the Hardinge approach. Thus, the use of the Hardinge approach in total hip arthroplasty may not be convenient in short subjects having borderline obesity.

Key words: Arthroplasty, replacement, hip/methods/adverse effects; body height/physiology; hip/innervation; hip joint/surgery; peripheral nerves/injuries.

A direct lateral approach to the hip was introduced in 1954 with the modification to the Kocher approach made by McFarland and Osborne. Hardinge made a further modification to the approach in 1982.^[1] This technique defined by Hardinge has

received considerable attention as it involves an incomplete or partial split of the gluteus medius tendon. Currently, this approach has become one of the most popular approaches in hip arthroplasty operations.

One of the complications of the Hardinge approach is damage to the inferior branch of the superior gluteal nerve (SGN). This is the main nerve stimulating the hip abductor muscles. Hardinge defined an area of 'safe zone' to protect the nerve and recommended not to go beyond this area.^[1,2] The size of the safe zone has been defined differently by various authors.^[3-6] Some cadaver studies showed that this safe zone might change in relation to the height of the patient and that the defined area might not always be safe as expected.^[7-9]

This study was designed to compare the morphometric parameters (height, weight, and body mass index) of patients who underwent total hip arthroplasty using the Hardinge approach, with or without the eventual development of a positive Trendelenburg sign.

Patients and methods

The study included 59 patients (43 women, 16 men; mean age 55 years; range 37 to 74 years) who underwent total hip arthroplasty via the Hardinge approach for primary coxarthrosis. All the patients were informed on the possible postoperative complications and informed consent was obtained from each patient. Involvement was in the right hip in 37 patients (62.7%) and in the left hip in 22 patients (37.3%). The mean operation time was 70 minutes (range 45 to 105 min). The patients were examined on an outpatient basis postoperatively at 15 days, and at the end of the first and third months. After the first three months, patients with and without a positive Trendelenburg sign were called for follow-up at monthly intervals and three-month intervals, respectively. None of the patients had clinical manifestations or radiographic changes of spondyloarthropathy pre- and postoperatively. The mean follow-up period was 24.3 months (range 12 to 37 months). The height, weight, and body

mass index values of the patients with and without a positive Trendelenburg sign were statistically compared with the Mann-Whitney U-test, using the SPSS ver. 15.0 software package. A *p* value of less than 0.05 was considered significant.

Surgical technique

The patients were prepared for surgery in the lateral decubitus position. Using a midlateral incision, the gluteal fascia and iliotibial band were reached (Fig. 1a). The gluteus medius muscle fibers were split and detached from the greater trochanter. The posterior two-thirds were left in position, whereas the anterior third was detached about 5 cm proximally in the longitudinal plane. This incision was continued to the distal end in a straight line to include the vastus lateralis fibers. The gluteus medius muscle and vastus lateralis tendon were detached from their insertions (Fig. 1b) and the anterior capsule of the hip was reached. The femoral head was dislocated anteriorly by external rotation and adduction maneuvers. The operation continued with routine total hip arthroplasty techniques.

Results

The Trendelenburg sign was positive in 19 patients (32.2%) following total hip arthroplasty with the Hardinge approach and persisted throughout a mean of 8.3 months (range 4-14 months). Patients with a positive Trendelenburg sign had a mean height of 157.4 ± 12.6 cm (range 151 to 173 cm), mean weight of 82.5 ± 18.9 kg (range 70 to 108 kg), and mean body mass index of 33.2 ± 9.3 kg/m² (range 25.4 to 30.5 kg/m²). The corresponding figures in patients without a Trendelenburg sign were as follows: 166.3 ± 11.4 cm (range 158 to 180 cm), 79.4 ± 9.2 kg (range 72 to 94 kg), and 28.7 ± 6.6 kg/m² (range 21.6 to 30.5 kg/m²). There was no significant difference between the two patient groups with respect

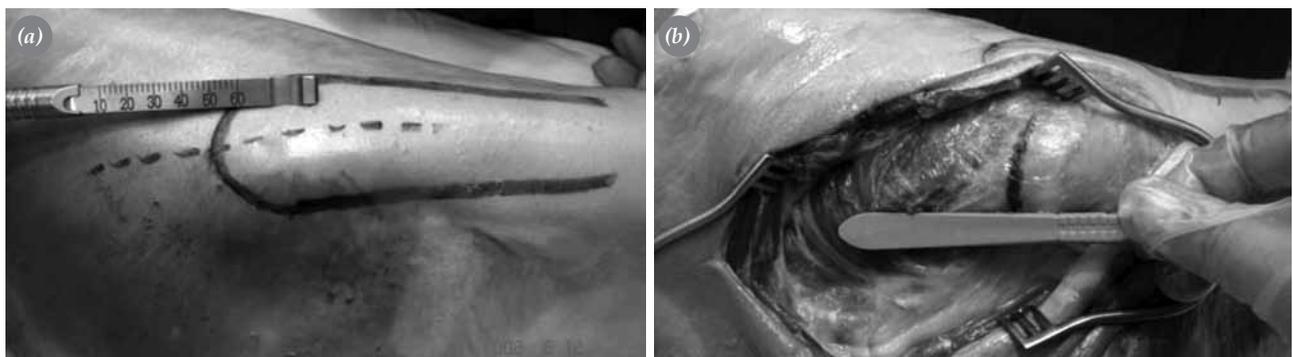


Fig. 1. (a) The Hardinge incision. (b) Separation of the gluteus medius from its insertion site.

to weight, but height and body mass index showed highly significant differences ($p < 0.0001$).

Discussion

The direct lateral approach modified by Hardinge is one of the most frequently used approaches in total hip arthroplasty.^[1,3,10] The most important cause for the development of a positive Trendelenburg sign associated with this approach is damage to the SGN. The association between the incision and damage to this nerve has been evaluated by several authors.^[9,11-15] It is a motor nerve supplying the gluteus medius, minimus, and tensor fascia lata. The branching and distribution of motor functions of the SGN were defined by Jacobs and Buxton in 1989.^[2]

The SGN ends in the middle third of the gluteus medius. The area extending to the end point of the nerve has been named as the safe zone. The extension of the safe zone to the greater trochanter has been examined by several authors and has been reported to be 3 cm to 7.82 cm.^[4-7] An extension of 5 cm has become the most widely accepted distance following the description by Ramesh et al.^[3] In a cadaver study, Ekşioğlu et al.^[7] demonstrated that the safe zone might change in relation to height and that a 5-cm distance above the greater trochanter might not always be a safe zone as expected. Based upon the results of a cadaver study, Bülbül et al.^[9] also warned that the 5-cm safe zone should be approached with caution in terms of reliability and safety. In another cadaver study, intraoperative damage to the SGN was linked with the height of the patient, and branching and anatomic position of the SGN.^[8] In our study, patients having a positive Trendelenburg test exhibited a significantly shorter height and greater body mass index, but weight was not a significant parameter between patients with and without Trendelenburg positivity.

Based on our finding that patients having a significantly shorter height and greater body mass index sustained Trendelenburg positivity for quite a long time (mean 8.3 months), we recommend that these two factors be taken into consideration in the preoperative evaluation of patients for total hip arthroplasty with the Hardinge approach. Thus, the use of the Hardinge approach in total hip arthroplasty may not be convenient in short subjects having borderline obesity as determined by body mass index.

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