INTRODUCTION:
In recent years, minimally invasive total hip arthroplasty (THA) without muscle detachment has been performed [1]. However, in the anterior approach, since the visual field on the femoral side is difficult to acquire, anterior femoral elevation is indispensable, and detachment of the articular capsule at appropriate sites (particularly the superoposterior site) is necessary. However, unless this detachment procedure and the rasping procedure are carefully performed, injury to the short external rotator muscles or piriformis may occur. Although anatomical insertions of these muscles have been known, there are no studies that precisely defined the attachment and morphology of these muscles that are necessary to avoid injury during the anterior approach. Therefore, we mapped the attachments of these muscles to greater trochanter in detail and evaluated the anatomic positional relationship.

MATERIALS AND METHODS:
The materials consisted of 17 hip joints (10 right joints and 7 left joints) of 14 cadavers (11 males and 3 females). The femur of each cadaver was dissected, and the piriformis and short external rotator muscles were identified. The attachment site of each muscle was carefully marked, and the tendon was detached. The long and short axes of the attachment area were measured. The femoral neck was cut at the saddle (Figure 1A) and the medial surface of the greater trochanter in the mediolateral (M-L) view of the femur, determined as the measurement surface, was photographed. Eight points (anterior, posterior, superior, inferior, anterosuperior, posteroinferior, superior and inferior middle point) of each attachment site were measured and recorded using Adobe photoshop CS2. In the M-L view of the femur, the bone axis in the proximal area was defined as the proximal femoral axis (Figure 1B). At the level of the femoral neck saddle, a perpendicular axis to the proximal femoral axis was defined as the X axis (A-P; anteroposterior axis), and an axis at the anterior border of the greater trochanter parallel to the proximal femoral axis was defined as the Y axis (vertical axis). Their intersection was defined as 0. For the mapping of the tendon attachment, the A-P position was expressed in percentages with the anterior border as 0% and the posterior border as 100%. The vertical position of tendon attachment was expressed with the saddle height as 0% and the vertex of the greater trochanter as 100% (Figure 1C).

RESULTS:
The short external rotator muscles (obturator internus, gemellus superior and gemellus inferior), excluding the obturator externus, attached to the the medial surface of the greater trochanter, in a form adjacent to one another. When the attachments of the 3 muscles were co-joined, the long axis of the attachment area was 12.8 ± 2.5 mm, and the short axis was 4.3 ± 1.2 mm. The attachment site of the piriformis was posterosuperior to that of the short external rotator muscles; the long axis of its attachment area was 10.3 ± 1.6 mm and the short axis was 4.7 ± 1.1 mm.

The position of the attachment site of the short external rotator muscle, excluding the obturator externus, varied considerably. On the coordinate axis, the attachment site ranged 18.8-43.2% (29.2 ± 6.9%) anteriorly, 38.9-59.8% (52.3 ± 5.2%) posteriorly, and 12.1-40.2% (26.5 ± 8.2%) inferiorly (red zone in Figure 2). The site for the piriformis ranged 42.1-76.9% (60.0 ± 10.4), 59.4-97.3% (80.0 ± 12.4), and 34.3-96.6% (58.7 ± 15.9), respectively (blue zone in Figure 2). Thus, the attachment sites and relative position of the short external rotator muscles and piriforms are not uniform among individuals.

DISCUSSION:
In THA, damage of the posterior soft tissue could induce postoperative instability [2] and posterior soft tissue repair is sometimes used in posterior approach THA to reduce the dislocation rate [3]. Therefore, preservation of as much posterior soft tissue as possible should lead to the early postoperative recovery and prevent dislocation [4]. An advantage of the anterior approach is thought to prevent such damage in the posterior soft tissue. However, for safe anterior elevation of the femur during the anterior approach THA, detachment of the short external rotator muscles is sometimes inevitable. Our present results indicated that the attachment site is fairly variable than it is generally thought and the short external rotator muscles can be mostly preserved after the detachment of the capsule 30% or less from the greater trochanter anteriorly and about 27% or less from the saddle. Thus, current study, presented possible landmark for the anterior approach and should help to minimize muscle injury.

REFERENCES: