A Geographic Zone Method to Describe Intra-articular Pathology in Hip Arthroscopy: Cadaveric Study and Preliminary Report

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Purpose: Our purpose was to develop an alternative method to divide the acetabulum and femoral head into different zones based on anatomic landmarks clearly visible during arthroscopy to facilitate reporting the geographic location of intra-articular injuries. **Methods:** Two vertical lines are positioned across the acetabulum aligned with the anterior and posterior limits of the acetabular notch. A horizontal line is positioned aligned with the superior limit of the notch perpendicular to the previous lines. The lines divide the acetabulum into 6 zones. Numbers are assigned to each zone in consecutive order. Zone 1 is the anterior-inferior acetabulum. The numbers progress around the notch until zone 5 is assigned to the posterior-inferior acetabulum. Zone 6 is the acetabular notch. The same method is applied to the femoral head. Six experienced hip arthroscopists were instructed in the zone and clock-face methods and were asked to identify and describe the geographic locations of lesions at the acetabular rim, acetabular cartilage, and femoral head in the same cadaveric specimen. **Results:** The zone method was more reproducible than the clock-face method in the geographic description of intra-articular injuries on the acetabulum and the femoral head. **Conclusions:** Among a group of expert hip arthroscopists, the zone method was more reproducible than the clock-face method. **Clinical Relevance:** The presented method divides the acetabulum into 6 different zones based on the acetabular notch. The zones are the same for right- and left-side hips. The same method is applied for the femoral head allowing, for the first time, a geographic description of pathology. **Key Words:** Hip arthroscopy—Topographic description—Articular lesions.

Literature regarding hip arthroscopy has increased greatly in the past few years.[1] An established methodology that follows a precise surgical technique has made hip arthroscopy safe and reproducible,[2] allowing more surgeons to routinely perform this procedure.[3] The hip joint is roughly spherical in shape, but its orientation does not fit neatly into the sagittal, axial, or coronal planes. This makes the geographic documentation of intra-articular lesions challenging.

Given that an increasing number of studies in the literature are seen as a result of the growing number of surgeons performing this procedure, a method to uniformly report the precise location of intra-articular injuries may be needed. Traditionally, the clock-face method has been used to topographically report intra-articular lesions of the acetabulum.[4] It is more complex, however, to apply this method to the femoral head. Although the clock-face method is easy to understand, there are some problems related to it: Sup-

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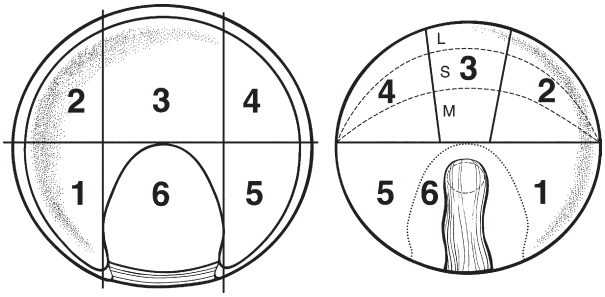

Figure 1. Right hip zones. The acetabular zones are to the left. Two vertical lines are drawn by use of the anterior and posterior notch walls as a reference. A horizontal line is drawn at the top of the acetabular notch. These lines divide the acetabulum into 6 different zones. Progressive numbers are assigned to each one of the zones, starting with number 1 at the anterior-inferior zone. Number 6 is assigned to the acetabular notch. The femoral head is to the right of the picture. The dashed line indicates the area that corresponds to the acetabular notch. Lines are positioned following the pattern of the lines used for the acetabulum. The head is presented dislocated in an "open-book fashion"; therefore the head is a "mirror image of the acetabulum." The numbers are assigned to each zone in a progressive fashion, starting with number 1 at the anterior-inferior head. Number 6 is assigned to the area corresponding to the acetabular notch. Zone 6 contains the ligamentum teres. In the femoral head, zones 2, 4, and 5 are subdivided into 3 areas: medial (M), superior (S), and lateral (L).

posing the 12-o'clock position is at the most lateral acetabular rim and 6 o'clock is at the middle of the transverse ligament; in the case of a right hip, the anterior acetabulum is located between 1 and 5 o'clock. For a left hip, the anterior acetabulum is located between 7 and 11 o'clock. The clock face can be artificially inverted for a left hip, which may be confusing for some surgeons. When the clock-face method is used, the 12-o'clock position is usually located at the most lateral and superior part of the acetabular rim and the 6-o'clock position is at the middle of the ligamentum transversum. Perception of these positions may be altered during the arthroscopic procedure as a result of acetabular inclination and anteversion.

Our purpose was to develop an alternative method to divide the acetabulum into different zones based on anatomic landmarks clearly visible during arthroscopy. We used these zones to describe the topographic location of intra-articular lesions. The same zone method was then applied to the femoral head. Our hypothesis was that the zone method is more reproducible for topographic description of articular injuries on the acetabular side in hip arthroscopy than the clock-face method. We also propose that the same zone method can be successfully applied to the femoral head.

METHODS

The acetabulum was divided into 6 different zones by use of the acetabular fossa as the principal landmark. Two vertical imaginary lines that follow the anterior and posterior limits of the acetabular fossa divide the acetabulum into 3 sections. A horizontal line perpendicular to the previous lines is placed at the superior limit of the fossa dividing the acetabulum into a superior and inferior half. As a result, the acetabulum is divided into 6 zones. The anterior-inferior zone is zone 1, anterior-superior is zone 2, mid-superior is zone 3, posterior-superior is zone 4, posterior-inferior is zone 5, and mid-inferior is zone 6. Zone 6 is the acetabular fossa (Fig 1). Each one of these lines is also positioned on the acetabular rim dividing the rim into 6 zones that correspond to the previously described zones. On the rim, zone 6 corresponds to the ligamentum transversum. The same system was then applied to the femoral head. The area that corresponds to the acetabular fossa is positioned on the femoral head around the ligamentum teres, and the same imaginary lines are then positioned on the femoral head following the same pattern that was used for the acetabulum. On the head, zones 2, 3, and 4 are subdivided into medial, superior, and lateral (Fig 2). The lateral subdivision corresponds to the uncovered

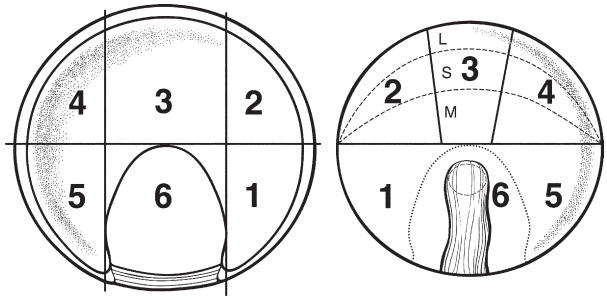

Figure 2. Left hip zones. The acetabular zones are to the left. Two vertical lines are drawn by use of the anterior and posterior notch walls as a reference. A horizontal line is drawn at the top of the acetabular notch. These lines divide the acetabulum into 6 different zones. Progressive numbers are assigned to each one of the zones, starting with number 1 at the anterior-inferior zone. Number 6 is assigned to the acetabular notch. The femoral head is to the right of the picture. The dashed line indicates the area that corresponds to the acetabular notch. Lines are positioned following the pattern of the lines used for the acetabulum. The head is presented dislocated in an "open-book fashion"; therefore the head is a "mirror image of the acetabulum." The numbers are assigned to each zone in a progressive fashion, starting with number 1 at the anterior-inferior head. Number 6 is assigned to the area corresponding to the acetabular notch. Zone 6 contains the ligamentum teres. In the femoral head, zones 2, 4, and 5 are subdivided into 3 areas: medial (M), superior (S), and lateral (L).

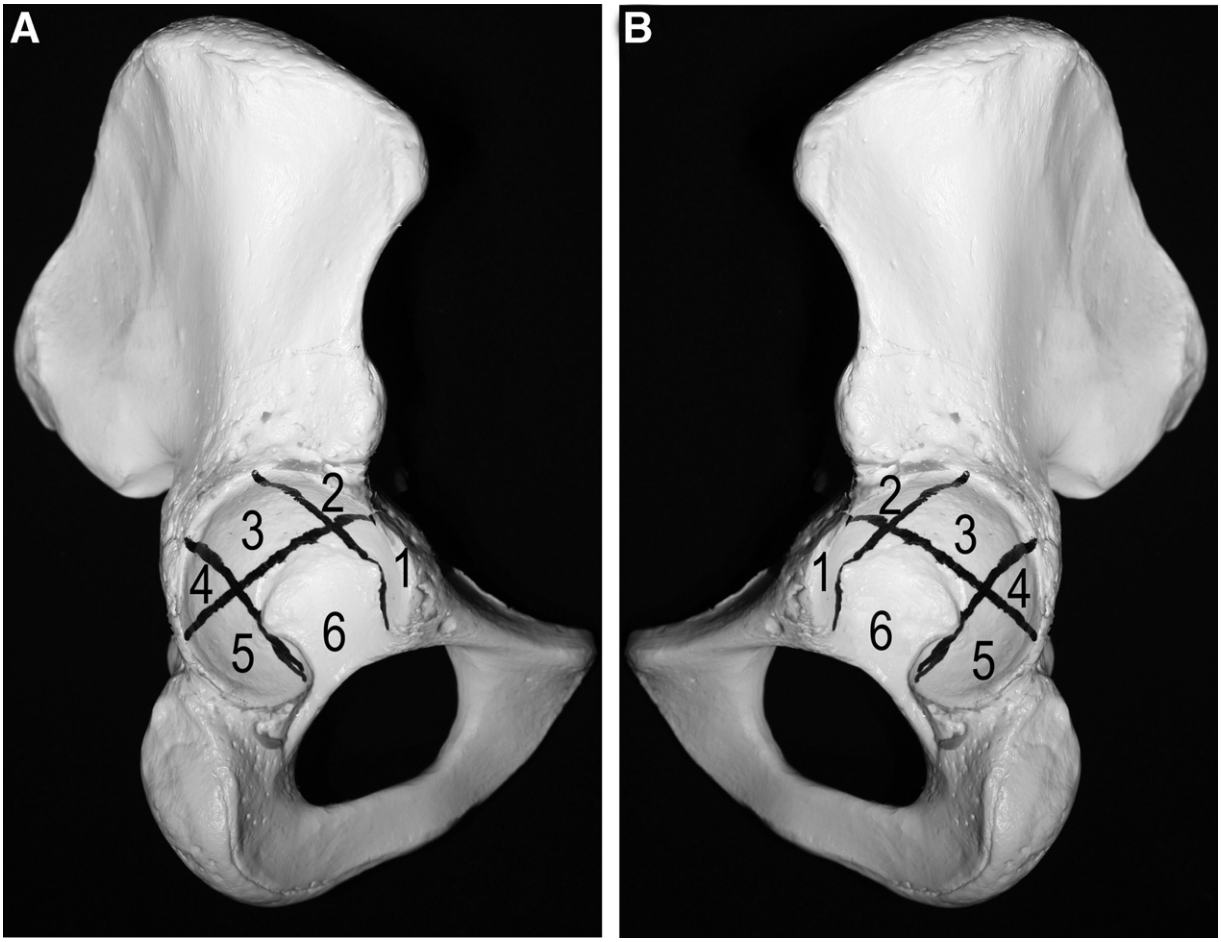

FIGURE 3. (A) Right hemipelvis model and (B) left hemipelvis model. The acetabulum has been subdivided into 6 zones. Zone 1 corresponds to the anterior-inferior acetabulum; zone 2, anterior-superior; zone 3, central superior; zone 4, posterior-superior; zone 5, posterior-inferior; and zone 6, acetabular notch.

portion of the femoral head in a neutral position. The assignment of numbers for the acetabulum (Fig 3) and femoral head (Figs 4 and 5) is always the same. Therefore anterior-inferior is always zone 1 for both right and left sides.

Application Study

Six surgeons who are experienced in hip arthroscopy (Master Instructors assembled for the Arthroscopy Association of North America hip course) performed diagnostic arthroscopy of the central compartment in a cadaveric hip specimen. Lesions on the acetabular cartilage, acetabular rim, and femoral head were previously positioned in the specimen by one of the authors. Each of the Master Instructors evaluated the central compartment of the specimen and was asked to describe the position of each lesion on the acetabular side using both the clock-face and zone systems. For the lesion on the femoral head, they were asked to describe its position using the zone system. Each of the Master Instructors was instructed in the use of both systems before examining the specimen.

We used a right-side cadaveric hip specimen, which was positioned supine with traction. Arthroscopic hip examination was done independently by each of the Master Instructors using the anterolateral and direct anterior portals. On the acetabular side, a linear cartilage lesion close to 1 cm in length was made with a spinal needle on the posterior-superior acetabulum. A radial labral tear was made at the anterior-inferior rim. On the femoral head, a linear cartilage lesion close to 1 cm in length was made at the anterolateral femoral head. Each examination was observed by one of the authors, who

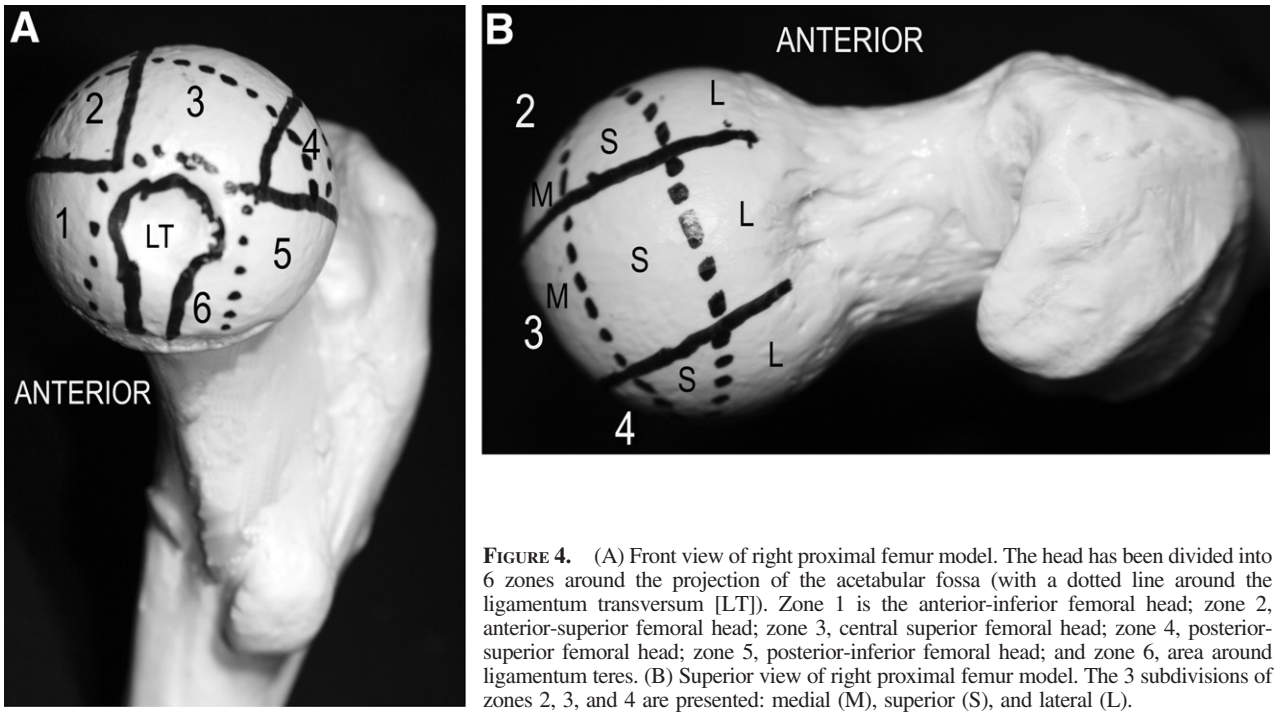

FIGURE 4. (A) Front view of right proximal femur model. The head has been divided into 6 zones around the projection of the acetabular fossa (with a dotted line around the ligamentum transversum [LT]). Zone 1 is the anterior-inferior femoral head; zone 2, anterior-superior femoral head; zone 3, central superior femoral head; zone 4, posterior-superior femoral head; zone 5, posterior-inferior femoral head; and zone 6, area around ligamentum teres. (B) Superior view of right proximal femur model. The 3 subdivisions of zones 2, 3, and 4 are presented: medial (M), superior (S), and lateral (L).

certified that the correct lesion was identified by the examiners and recorded the observations.

Statistical Analysis

A reliability analysis of the observations for both the acetabular cartilage lesion and the labral lesion was performed. Because the zone system has only 6 probable areas of topographic location of the lesions and the clock-face method has 12 hours that can each be subdivided into minutes, the clock-face method was superimposed onto the zones for the statistical analysis. Therefore in our observations (right hip specimen) hours between 1:01 and 3:00 corresponded to zone 2, 3:01 to 5:00 corresponded to zone 1, 5:01 to 7:00 corresponded to zone 6, 7:01 to 9:00 corresponded to zone 5, 9:01 to 11:00 corresponded to zone 4, and 11:01 to 1:00 corresponded to zone 3.

RESULTS

Every observer was able to identify the correct lesion on the acetabular cartilage, the labrum, and the femoral head. On the acetabular side, the acetabular cartilage lesion was described as being in zone 4 by 4 observers, and 2 observers indicated that the lesion was between zones 3 and 4. When the clock-face method was applied to the same acetabular cartilage lesion, one observation was made at 9 o'clock, one at 11, one at 12, one at 10, one at 9:30, and one at 1. Every observer described a different time. When the labral lesion was described, every observer positioned it in zone 1. With the clock-face method, the lesion was described as being at 4 o'clock by 3 observers, at 3 by 2 observers, and at 3:30 by 1 observer (Table 1).

The cartilage lesion at the femoral head was positioned by every observer at zone 2. Four observers determined that the lesion was at zone 2L (2 lateral) and 2 observers said it was at zone 2S (2 superior).

Overall, 36 possible observations (6 zones and 6 observers) were done for each lesion on the acetabular side. By use of the zone method for acetabular cartilage lesions, considering uninjured and injured zone observations, the inter-item correlation coefficient was 0.943, with an α reliability coefficient (Cronbach) of 0.962 (0.971 with standardized items) ($P = .0001$). For the adapted-to-zones clock-face method, the inter-item correlation coefficient was 0.934, with an α reliability coefficient (Cronbach) of 0.950 (0.966 with standardized items) ($P = .0001$).

For the labral lesion, the inter-item correlation coefficient was 1.0 and the α reliability coefficient (Cronbach) was 1.0 because every observer positioned the lesion in zone 1. For the adapted clock-face method, the inter-item correlation coefficient was 0.96

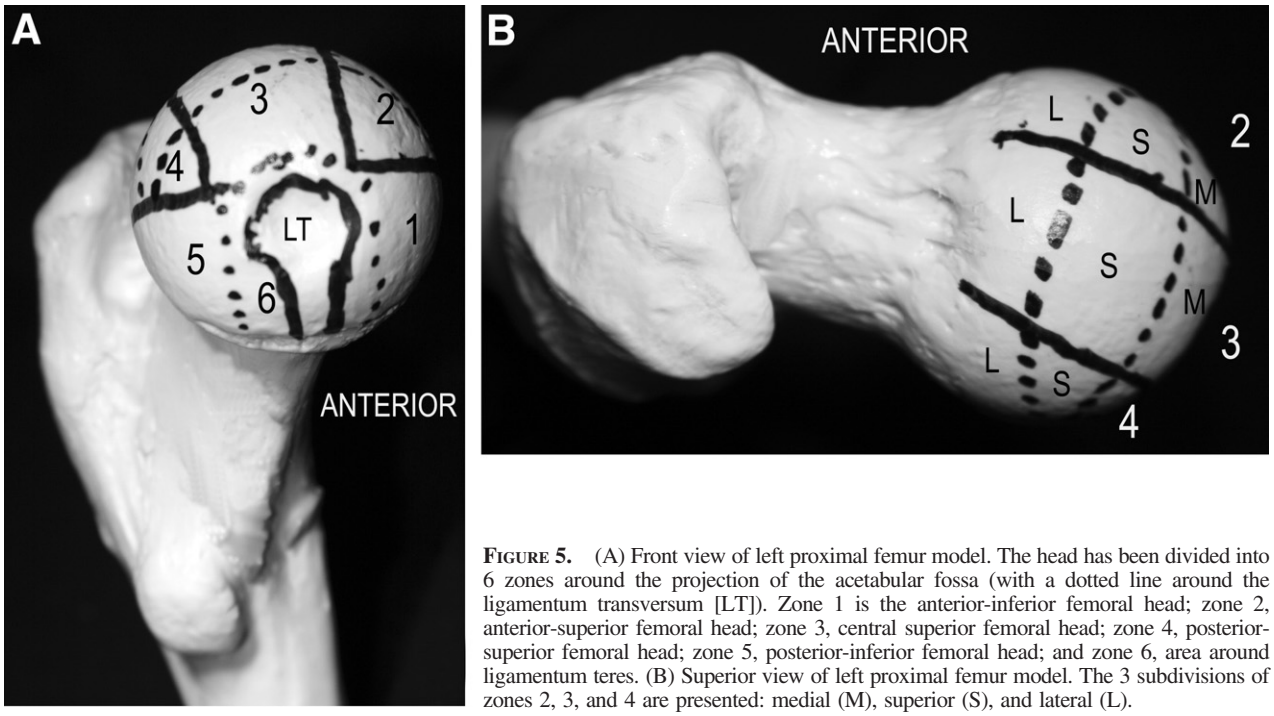

FIGURE 5. (A) Front view of left proximal femur model. The head has been divided into 6 zones around the projection of the acetabular fossa (with a dotted line around the ligamentum transversum [LT]). Zone 1 is the anterior-inferior femoral head; zone 2, anterior-superior femoral head; zone 3, central superior femoral head; zone 4, posterior-superior femoral head; zone 5, posterior-inferior femoral head; and zone 6, area around ligamentum teres. (B) Superior view of left proximal femur model. The 3 subdivisions of zones 2, 3, and 4 are presented: medial (M), superior (S), and lateral (L).

and the α reliability coefficient (Cronbach) was 0.94, both with $P = .0001$.

DISCUSSION

The clock-face method has been used as the standard for describing intra-articular hip pathology on the acetabulum and the acetabular rim. When used adequately, it places the 6-o'clock position at the center of the ligamentum transversum and the 12-o'clock position on the most lateral aspect of the rim opposite to the 6-o'clock position.[4] Perception of the 6-o'clock position may be altered arthroscopically because of patient positioning, as well as acetabular anteversion and inclination. The main problem with the clock-face method is that the position of the hours is not the same for the right and left acetabula. This can be compensated for by artificially altering the position of the hours for the left hip,[4] which can be confusing for some surgeons. The other option is to accept the different hours for left and right acetabula. The zone method divides the acetabulum into 6 zones. Perception of the location of each one of the zones is not affected by patient positioning or acetabular anteversion and inclination because it is based on the acetabular fossa. The numeric order of the zones is not affected when applied to a left or right acetabulum because number 1 is always assigned to the anterior-inferior zone; number 2, the anterior-superior zone; number 3, the central superior zone; number 4, the posterior-superior zone; number 5, the posterior-inferior zone; and number 6, the acetabular fossa. This method was also applied to the femoral head with reliability and reproducibility and, to our knowledge, is the first method for geographic description of femoral head lesions.

The location of intra-articular lesions in the hip may help define a particular pathologic process and may have implications for prognosis.[4-6] Adequate topographic description of these lesions is important for medical records as well as data collection.

TABLE 1. *Observations*

	Acetabular Lesion		Labral Lesion	
	Zone Method	Clock-Face Method	Zone Method	Clock-Face Method
Observer 1	Zone 4	9	Zone 1	4
Observer 2	Zone 4	11	Zone 1	4
Observer 3	Between zones 3 and 4	12	Zone 1	3
Observer 4	Between zones 3 and 4	10	Zone 1	3
Observer 5	Zone 4	9:30	Zone 1	3:30
Observer 6	Zone 4	1	Zone 1	4

The weaknesses of this study are that the zone and clock-face methods were only evaluated by a small number of hip arthroscopy experts who were very experienced in using the clock-face method and contributed to the development of the zone method. Differences between the methods may be more evident if evaluated by less educated observers. Only a right hip specimen was evaluated when the cadaveric study was performed because we wanted to use the clock-face method in the best conditions (without the problem of left-side hours). Differences may also be more evident if the evaluations are performed in a left hip. A future study will include observations in left and right specimens made by less experienced observers.

CONCLUSIONS

We describe a simple and reproducible method for geographic location and description of intra-articular lesions in the hip joint that was designed and approved by consensus of a panel of hip experts. Among a group of expert hip arthroscopists, the zone method was more reproducible than the clock-face method.

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