Safe Angle of Anchor Insertion for Labral Repair During Hip Arthroscopy

Michael Stanton, M.D., and Michael Banffy, M.D.

Purpose: To compare the use of the distal anterolateral accessory (DALA) portal with the anterolateral (AL) and midanterior (MA) portals during arthroscopic hip labral repair. **Methods:** Standard AL, MA, and DALA portals were created on 6 cadaveric hip specimens. Four 2.4-mm pins were placed in the acetabular rim to the depth of a standard anchor using a drill guide. Pins were placed in the 12 to 3 o'clock positions. The specimens then underwent computed tomographic scans with the pins left in place, and the distance from the pin to the articular surface was calculated at different depths of insertion. **Results:** In the anterior location, the average starting distance for the DALA pin was 2.05 mm and for the MA pin it was 2.51 mm from the articular surface ($P = .29$). Statistically significant differences between the DALA and MA pins were found at depths of 6 mm ($P = .04$) and 9 mm ($P = .03$). In the superior location, the average starting distance for the DALA pin was 2.40 mm and for the AL pin it was 2.62 mm from the articular surface ($P = .34$). Statistically significant differences between the DALA and AL pins were found at depths of 6 mm ($P = .02$), 9 mm ($P = .01$), 12 mm ($P = .01$), 15 mm ($P = .04$), and 18 mm ($P = .04$). **Conclusions:** The DALA portal allows pins to be placed at a greater distance from the articular surface than the MA and AL portals when using a straight drill guide. This may decrease the incidence of intra-articular penetration during arthroscopic hip labral repair. **Clinical Relevance:** Intra-articular penetration of a drill bit or anchor is an iatrogenic complication that can occur during labral repair. By using the DALA portal instead of the AL and MA, the anchor can be safely placed on the acetabular rim and directly away from the articular surface, decreasing the chance for this complication.

See commentary on page 1798

Hip arthroscopy continues to be a growing field in sports medicine, with femoral-acetabular impingement and labral tears being common indications for surgery. Excellent clinical results have been reported in the literature for both labral debridement and repair; however, improved functional outcomes have been shown with labral repair.[1-4]

The labrum is a horseshoe-shaped structure that increases the articular surface area by 22% to 33%. The main role of the acetabular labrum is to create a suction seal effect, maintaining a negative pressure within the hip joint. Stability of the hip is improved by the suction seal effect by resisting distractive forces on the hip. Labral tears have been shown to decrease the force needed to distract the hip, and labral repairs can restore near normal distractive forces.[5-7]

Several techniques for labral repairs have been described in the literature, including both loop fixation techniques and labral base techniques.[8-11] Both techniques include placement of a suture anchor in the acetabular rim to provide an anatomic fixation. One technical error described with anchor placement is inadvertent articular cartilage penetration with the drill or anchor during labral repair.[12] Several articles have attempted to identify a safe angle for anchor placement in different regions of the acetabulum as well as modifying the portals to create a better angle for anchor placement.[13-16]

Several arthroscopic portals have been described for use during hip arthroscopy.[16,17] Commonly used portals for intra-articular work including labral repair are the standard anterolateral (AL) and midanterior (MA) portals. The distal anterolateral accessory (DALA) portal is an accessory portal described mostly in the literature for work within the peritrochanteric space; however, several surgeons have described the use of the DALA

From the Kerlan-Jobe Orthopaedic Clinic, Los Angeles, California, U.S.A.

The authors report the following potential conflict of interest or source of funding: M.B. receives support from Stryker Endoscopy, Law Firm NOS, and Arthrex. Material and instrument support was provided by Arthrex.

Received September 11, 2015; accepted February 3, 2016.

Address correspondence to Michael Stanton, M.D., 4 Phila Street, Mendon, NY 14506, U.S.A. E-mail: michaelc.stanton@gmail.com

0749-8063/15817/$36.00

http://dx.doi.org/10.1016/j.arthro.2016.02.013

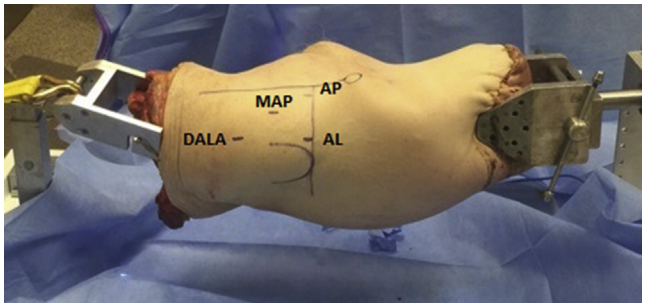

Fig 1. Custom distraction setup and anterolateral, midanterior, and distal anterolateral accessory portals used in the study. (AL, anterolateral; AP, anterior portal; DALA, distal anterolateral accessory; MAP, midanterior portal.)

portal for placing suture anchors in the acetabular rim.[15,17] This study compared the use of the DALA portal with the AL and MA portals during arthroscopic hip labral repair. When repairing the acetabular labrum, we hypothesized that the DALA portal would create a better angle to decrease the chance of intra-articular penetration compared with the MA or AL portal.

Methods

Six cadaveric hip specimens obtained from Arthrex, Naples, Florida, were used during this study. Four male and 2 female specimens with an average age of 79.5 (range 57 to 90) were mounted to a custom distraction table to apply gentle traction to hip joint after venting of capsule with a spinal needle. No specimens were excluded from this study, but consideration for excessive dysplasia was considered. All specimens were frozen specimens and were thawed for the arthroscopy portion of the study (Fig 1). Standard AL, MA, and DALA portals were created based on anatomic landmarks as previously published.[17] The AL portal was placed 1 cm superior and 1 cm anterior to the tip of the greater trochanter. The MA portal was created by making an equilateral triangle using the AL portal and a standard anterior portal that is placed 1 cm lateral to the ASIS in line with the AL portal. The DALA portal was created by drawing a triangle between the MA and AL portals and a point distal but in line with the AL portal. The distance between the AL and MA portals was equal to the distance between the MA and the DALA portals (Fig 2).

A standard 70° arthroscope was introduced into the joint and a limited interportal capsulotomy was created between the AL and MA portals. The anterosuperior acetabular rim was identified and divided into 2 anatomic locations. The superior location was described between the 12 and 1 o'clock position and the anterior location was described between the 2 and 3 o'clock position.

Prior to arthroscopy, the specimens were randomized to the order of pin placement starting in the anterior 3 o'clock position. A 2.4-mm pin was placed in the anterior location from either the DALA or MA portal, followed by a second pin placed in the 2 o'clock position from the other portal. Furthermore, 2.4-mm pins were placed in the superior location from either the DALA or the AL portal in a similar fashion at the 1 and 12 o'clock positions. All pins were placed using a straight drill guide to a depth of approximately 20 mm. All pins were placed at the acetabular-labral junction approximately 2 to 3 mm from the articular surface. The joint was visualized to monitor for intra-articular penetration. Pin trajectory would not be adjusted if intra-articular penetration occurred. A total of 4 pins were placed in each specimen, 2 pins in each location. Pins in each location were separated by approximately 3 to 4 mm (Figs 3 to 5).

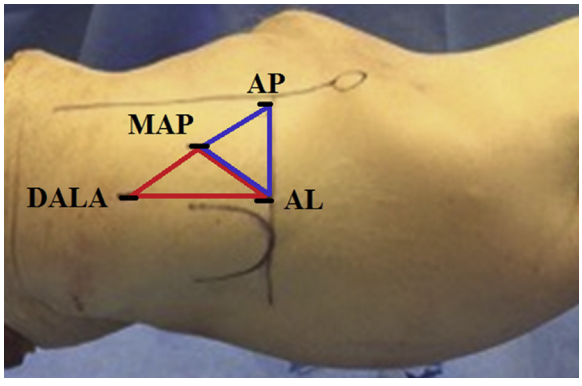

Fig 2. Demonstration of how the anterolateral, midanterior, and distal anterolateral accessory portals were created in the study. (AL, anterolateral; AP, anterior portal; DALA, distal anterolateral accessory; MAP, midanterior portal.)

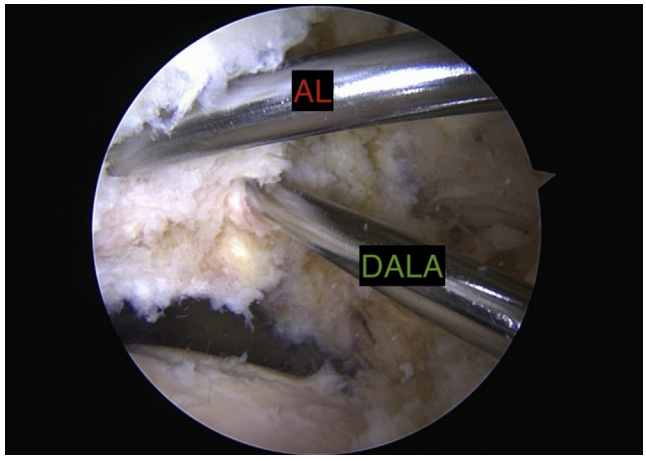

Fig 3. Arthroscopic view of left hip from midanterior portal displaying pins placed from the anterolateral (AL) and distal anterolateral accessory (DALA) portals. Pins were being placed into the superior acetabulum. Specimen was secured representing the supine patient position.

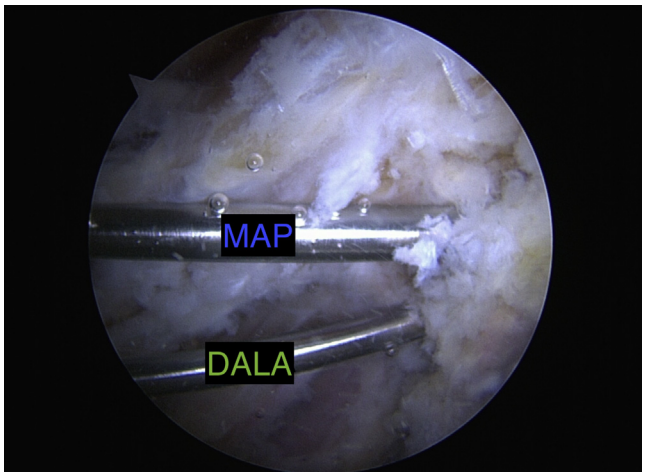

Fig 4. Arthroscopic view of left hip from midanterior portal displaying pins placed from the midanterior portal (MAP) and distal anterolateral accessory (DALA) portal. Pins were being placed into the anterior acetabulum. Specimen was secured representing the supine patient position.

All specimens then underwent computed tomographic scans using a Siemens scanner, SOMATOM Definition (64-slice dual-source computed tomograph) with a 140-KVP, 450-mAs technique. Sagittal and coronal reconstructions were obtained at 1-mm slice thickness. The distance from each pin to the articular surface was calculated at 3-mm-depth increments from 0 to 18 mm of depth by a single observer (M.S.) using the DICOOM measuring software (Fig 6). A depth of 18 mm was chosen as this is the length of a standard implant used during labral repair.

The average distance from pin to articular surface was calculated for each portal at both the superior and anterior locations. In the anterior location, paired *t* tests were used to calculate statistical significance between the DALA and MA portals. Similarly, for the superior location, paired *t* tests were used to calculate statistical significance between the DALA and AL portals.

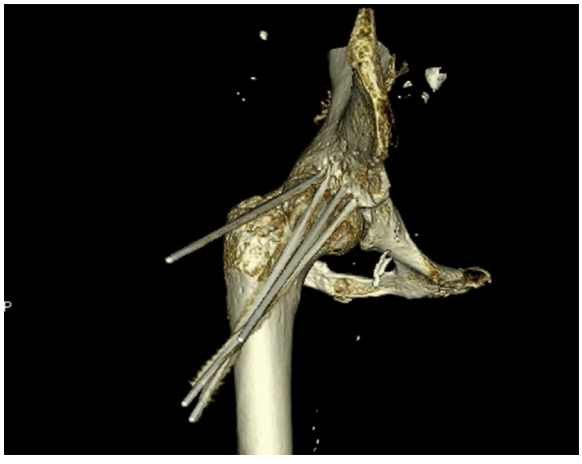

Fig 5. Three-dimensional reconstruction of a specimen demonstrating pin placement across the anterior and superior acetabular rims.

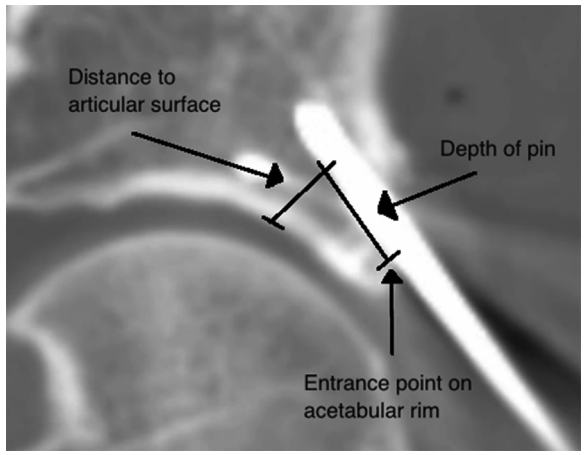

Fig 6. Example of measurement calculation of pin depth and distance to articular surface using a computed tomographic scan.

Results

In the anterior location, the average starting distance for the DALA pin was 2.05 mm and for the MA pin it was 2.51 mm from the articular surface. The difference was not statistically significant ($P = .29$). Statistically significant differences between the DALA and MA pins were found at depths of 6 and 9 mm ($P < .05$), with the MA portal remaining closer to the articular surface throughout the length of the pin. No statistical significance was found at depths of 3, 12, 15, and 18 mm (Fig 7). The minimal distance for the DALA portal was 1.34 mm at a depth of 0 mm. The minimal distance for the MA portal was 1.15 mm at a depth of 3 mm.

In the superior location, the average starting distance for the DALA pin was 2.40 mm and for the AL pin was 2.62 mm from the articular surface. The difference was not statistically significant ($P = .34$). Statistically significant differences between the DALA and AL pins were found at depths of 6, 9, 12, 15, and 18 mm ($P < .05$), with the AL portal remaining closer to the articular surface throughout the length of the pin. No statistical significance was found at a depth of 3 mm ($P = .06$) (Fig 8). The minimal distance for the DALA portal was 1.30 mm at a depth of 0 mm. The minimal distance for the AL portal was 0.84 mm at a depth of 6 mm.

All pins were placed safely, with the entirety of the pin within the acetabular bone. No pin violated the articular surface from any of the 3 portals tested in this study.

Discussion

The more distal position of the DALA portal allowed a better trajectory of drill placement than both the AL and MA portals. The DALA portal demonstrated a near

Anterior Position

Pin Depth	0 mm	3 mm	6 mm	9 mm	12 mm	15 mm	18 mm
DALA	2.05	3.11	3.94	4.93	6.10	8.01	9.12
MAP	2.51	2.46	2.65	2.96	3.80	5.26	7.08
p Value	0.29	0.27	0.04	0.03	0.07	0.06	0.22

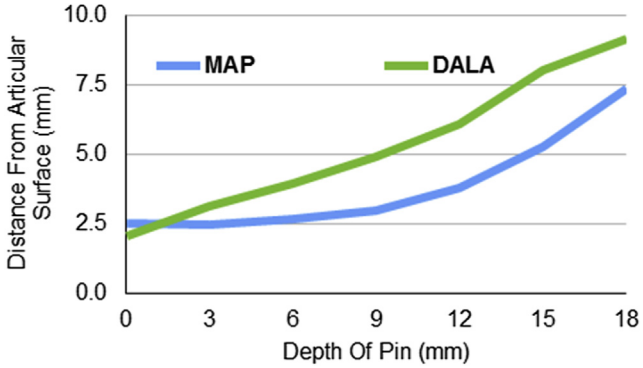

Fig 7. Data representing average distance in millimeters from the pin to the articular surface at specific pin depths for each of the distal anterolateral accessory (DALA) portal and midanterior portal (MAP). Pins were placed in the anterior portion of the acetabular rim from the 2 to 3 o'clock position.

linear trajectory angling away from the joint from the insertion point on the acetabular rim. Both the AL and MA portals demonstrate a trajectory that is more parallel to the joint surface at initial depths of drill insertion. This makes the starting depth more critical for the MA and AL portals, as the likelihood of intra-articular penetration may be greater if the starting position is closer to the articular surface.

Labral repair or refixation after treatment for femoral acetabular impingement can be difficult because of the morphologic characteristics of the acetabular rim and the angle of insertion of the suture anchor.[14] Nonanatomic placement of the suture anchor can compromise the function of the repaired labrum. Suture anchors placed at a distance too far from the articular surface risk everting the labrum, causing a loss of its normal suction seal effect. Suture anchors placed too close to the articular surface risk violating the joint, causing damage to the articular surface. Although the incidence of cartilage damage and clinical significance due to intra-articular penetration of the drill bit is not known, case reports have described revision hip arthroscopy due to anchor-induced chondral damage when left within the joint.[12]

The morphologic characteristics of the acetabular bone are variable according to the location along the acetabular rim.[14] Different portals are typically used for the various locations along the acetabular rim to provide a better angle of anchor insertion. The use of curved drills has been shown to provide a safer angle of anchor insertion than a straight guide when placed through the DALA portal at the 2 and 3 o'clock positions.[15] However, this study did not compare anchor insertion from either the MA or AL portal.

A recently published study attempted to investigate the safety of placing suture anchors from different portals.[18] The authors using a custom guide to simulate the MA and DALA portals would be placed to re-create the angle of insertion of their drill guide. This study did not find a statistically significant difference between the MA and DALA portals. However, the use of the simulated guide on a dissected cadaveric specimen compared with hip arthroscopy, and testing the specimens only between the 3 and 4 o'clock positions, might have accounted for the differences seen in our study.

Limitations

At each location, pins were placed from 2 portals and separated by 3 to 4 mm. Although specimens were randomized to the order of pin placement, morphologic differences between specimens cannot be accounted for.

Superior Position

Pin Depth	0 mm	3 mm	6 mm	9 mm	12 mm	15 mm	18 mm
DALA	2.40	3.68	4.66	5.39	6.26	7.54	9.19
AL	2.62	2.52	2.63	3.04	3.09	3.41	4.60
p Value	0.34	0.06	0.02	0.01	0.01	0.04	0.04

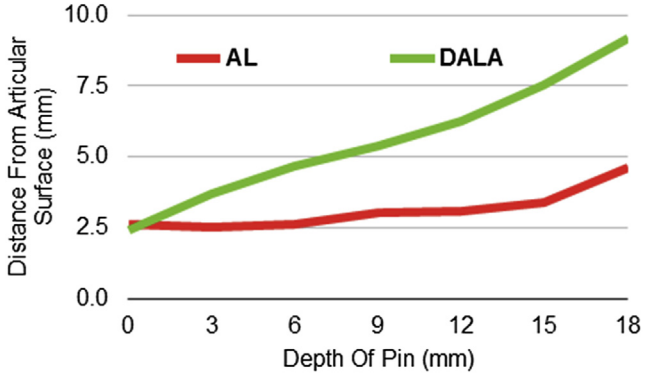

Fig 8. Data representing average distance in millimeters from the articular surface at specific depths for each of the distal anterolateral accessory (DALA) and anterolateral (AL) portals. Pins were placed in the superior portion of the acetabular rim from the 12 to 1 o'clock position.

Conclusions

The DALA portal allows pins to be placed at a greater distance from the articular surface than the MA and AL portals when using a straight drill guide. This may decrease the incidence of intra-articular penetration during arthroscopic hip labral repair.

References

1. Espinosa N, Rothenfluh DA, Beck M, Ganz R, Leunig M. Treatment of femoro-acetabular impingement: Preliminary results of labral refixation. *J Bone Joint Surg Am* 2006;88:925-935.
2. Larson CM, Giveans MR. Arthroscopic debridement versus refixation of the acetabular labrum associated with femoroacetabular impingement. *Arthroscopy* 2009;25:369-376.
3. Philippon MJ, Briggs KK, Yen YM, Kuppersmith DA. Outcomes following hip arthroscopy for femoroacetabular impingement with associated chondrolabral dysfunction: Minimum two-year follow-up. *J Bone Joint Surg Br* 2009;91:16-23.
4. Larson CM, Giveans MR, Stone RM. Arthroscopic debridement versus refixation of the acetabular labrum associated with femoroacetabular impingement: Mean 3.5-year follow-up. *Am J Sports Med* 2012;40:1015-1021.
5. Ferguson SJ, Bryant JT, Ganz R, Ito K. The acetabular labrum seal: A poroelastic finite element model. *Clin Biomech (Bristol, Avon)* 2000;15:463-468.
6. Ferguson SJ, Bryant JT, Ganz R, Ito K. The influence of the acetabular labrum on hip joint cartilage consolidation: A poroelastic finite element model. *J Biomech* 2000;33:953-960.
7. Ferguson SJ, Bryant JT, Ganz R, Ito K. An in vitro investigation of the acetabular labral seal in hip joint mechanics. *J Biomech* 2003;36:171-178.
8. Kelly BT, Weiland DE, Schenker ML, Philippon MJ. Arthroscopic labral repair in the hip: Surgical technique and review of the literature. *Arthroscopy* 2005;21:1496-1504.
9. Philippon MJ. New frontiers in hip arthroscopy: The role of arthroscopic hip labral repair and capsulorrhaphy in the treatment of hip disorders. *Instr Course Lect* 2006;55:309-316.
10. Philippon MJ, Schenker ML. A new method for acetabular rim trimming and labral repair. *Clin Sports Med* 2006;25:293-297.
11. Fry R, Domb B. Labral base refixation in the hip: Rationale and technique for an anatomic approach to labral repair. *Arthroscopy* 2010;26:S81-S89 (9 suppl).
12. Matsuda D, Bharam S, White BJ, Matsuda NA, Safran M. Anchor-induced chondral damage in the hip. *J Hip Preserv Surg* 2015;2:56-64.
13. Hernandez JD, McGrath BE. Safe angle for suture anchor insertion during acetabular labral repair. *Arthroscopy* 2008;24:1390-1394.
14. Lertwanich P, Ejnisman L, Torry MR, Giphart JE, Philippon MJ. Defining a safety margin for labral suture anchor insertion using the acetabular rim angle. *Am J Sports Med* 2011;39:111S-116S (suppl).
15. Nho SJ, Freedman RL, Federer AE, et al. Computed tomographic analysis of curved and straight guides for placement of suture anchors for acetabular labral refixation. *Arthroscopy* 2013;29:1623-1627.
16. Thomas Byrd JW. Modified anterior portal for hip arthroscopy. *Arthrosc Tech* 2013;2:e337-e339.
17. Robertson WJ, Kelly BT. The safe zone for hip arthroscopy: A cadaveric assessment of central, peripheral, and lateral compartment portal placement. *Arthroscopy* 2008;24:1019-1026.
18. Foster A, Ryan J, Ellis T, Flom J. Safe suture anchor insertion for anterior and posterior hip labral repair. *J Hip Preserv Surg* 2015;2:170-174.