Intra-articular Volume Reduction With Arthroscopic Plication for Capsular Laxity of the Hip: A Cadaveric Comparison of Two Surgical Techniques

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Purpose: To compare intracapsular volume reduction between interportal capsular shift and T-capsulotomy plication in a cadaveric model. **Methods:** Twelve pair-matched specimens were randomized into T-capsulotomy plication or interportal capsular shift. T-capsulotomy was performed using a 2-cm interportal and 2-cm bisecting, longitudinal limb to the intertrochanteric line. Plication was performed utilizing 5-mm bites on either side of the capsulotomy with arthroscopic knot tying technique standard alternating half hitches. Pair-matched interportal capsular shift specimens underwent 5-cm interportal capsulotomy, and capsular shift was performed utilizing 5 nonabsorbable sutures placed in 45° orientation at 5 mm from the capsulotomy margin. With each specimen in a position of slight flexion and adduction, a spinal needle was used to inject methylene blue-colored saline solution intra-articularly; the volcano method was used to measure capsular volume before and after each respective plication technique. Mean absolute volumes and relative volumetric reduction for each technique were quantified and compared to determine statistical significance. **Results:** At baseline, there were no statistically significant differences in capsular volume between pair-matched specimens (T-capsulotomy plication, 42.5 ± 5.1 mL; interportal capsular shift, 45.0 ± 88.6 mL; $P = .555$). After capsulotomy and secondary plication, both the T-capsulotomy (post: mean = 32.5 ± 8.0 mL; $P < .001$) and interportal capsulotomy groups (post: mean = 29.4 ± 10.0; $P < .0001$) demonstrated significant decreases in capsular volume, with average reductions of 10.0 ± 3.3 mL and 15.6 ± 3.2 mL, respectively. Although the interportal capsular shift (35.9% ± 11.3%) demonstrated greater volumetric reduction relative to baseline when compared with the T-capsular plication (24.5% ± 10.8%), these results were not significant ($P = .104$). **Conclusions:** Both T-capsular plication and interportal capsular shift produce statistically significant reductions in overall hip capsular volume. Although the interportal capsular shift may generate modestly higher degrees of capsular reduction, the comparative biomechanical repercussions of each technique are not currently known. **Clinical Relevance:** Irrespective of arthroscopic technique, capsular plication with 5-mm bites decreases capsular volume by approximately one-third to one-fourth that of baseline measures.

Hip capsular laxity and hypermobility are associated with increased hip flexion during trunk movement and the development of labral tears as a result of abnormal contact between the femoral head and acetabulum. This may be attributable to inherent soft tissue laxity in patients with connective tissue disorders such as Ehlers-Danlos syndrome or Marfan syndrome. It can also develop as a result of strenuous training with compensatory soft tissue laxity. Individuals participating in athletic activities requiring repetitive motions may result in microtrauma to the capsule, leading to capsular redundancy and microinstability.[1,2]

The capsule is an important hip stabilizer, and repair or plication is essential in preventing postoperative

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instability.[1,3] After a report of anterior hip dislocation in a patient undergoing hip arthroscopy for the treatment of femoroacetabular impingement in the presence of capsular laxity,[4] it has become apparent that proper capsular management for patients first seen with hyperlaxity and hypermobility is required. Furthermore, Han et al.[5] have demonstrated that capsular laxity alters normal kinematics of the hip, with the potential to result in abnormal femoral-acetabular contact and joint degeneration. Capsular plication has been recommended for these patients.[1,3,6] The aim of capsular plication is to restore or improve joint stability.

Although arthroscopic management with capsular plication has been recommended for treatment of combined hip pathology, the extent of volumetric reduction with established techniques has not been elucidated. The purpose of this study is to compare intracapsular volume between interportal capsular shift and T-capsulotomy plication in a cadaveric model. It was hypothesized that no significant difference exists between these 2 popular techniques in terms of relative and absolute levels of volumetric reduction.

Methods

Six matched pairs of hemipelvis and proximal femur human cadaver specimens (12 total specimens) were obtained from ScienceCare thawed, dissected to the level of the hip capsule, and used for testing the changes in capsular volume after T-capsulotomy followed by open capsular plication (6 specimens) or interportal capsulotomy (6 specimens) using arthroscopic instrumentation followed by capsular shift. All the specimens were assessed by a board-certified, fellowship-trained orthopaedic surgeon, orthopedic surgery sports medicine fellow, and third-year medical student. Institutional review board approval was not required because deidentified cadaveric specimens were used.

Native capsular volume was obtained from each specimen in a position of neutral rotation, slight flexion (20°), and slight adduction (20°) by injecting a dilute methylene blue/saline solution with an 18-gauge spinal needle and 60-mL syringe until firm resistance was met in the syringe or until immediate overflow ("volcano method") of fluid occurred at the needle insertion site.[7,8] In brief, the so-called volcano method was employed for both the capsular plication techniques. By means of a standard anterior approach, the joint was insufflated with normal saline impregnated with methylene blue dye in 5-mL increments. On positive backflow into the syringe or overflow at the site of injection, volumetric measurements were recorded. A standard T-capsulotomy was performed on 1 set of the pair-matched specimens using a 2-cm interportal adjacent and parallel to the labrum from 1 o'clock to 3 o'clock and 2-cm bisecting, longitudinal limb to the level of the intertrochanteric line (Fig 1). T-capsulotomy plication (TCP) was performed with 3 No. 2 high-tensile nonabsorbable sutures (Force Fiber; Stryker, Kalamazoo, MI) tied in each limb of the T, utilizing 5-mm bites (measured with a ruler) on either side of the capsulotomy and an arthroscopic knot-tying technique of standard alternating half hitches (Fig 2). The distance between suture limbs was 10 mm and was measured with a ruler as well. The other half of the pair-matched specimens underwent a 5-cm interportal capsulotomy from 11 o'clock to 4 o'clock (Fig 3). Interportal capsular shift (IPCS) was performed using 5 high-tensile nonabsorbable sutures placed in a medial 45° orientation from the proximal to distal capsulotomy margin (Fig 4). As with the TCP, 5-mm bites were taken from either side and knots were tied by using a similar technique. The T-capsulotomy and IPCS were performed in a similar fashion as previously described in the literature.[3,9]

Before the capsular volume was measured after plication or shift, the superficial layer of the capsulotomy was oversewn with 3-0 monofilament sutures, and 2-octyl cyanoacrylate was applied to create a watertight seal. Dermabond glue was used to ensure a watertight seal was maintained, particularly at the site of dye injection. Of note, none of the cadaveric hips used had any capsular defect. With the specimens in the

Fig 1. Standard (left hip) T-capsulotomy: 2-cm interportal incision adjacent and parallel to the labrum from 1 o'clock to 3 o'clock and 2-cm bisecting, longitudinal limb to the level of the intertrochanteric line.

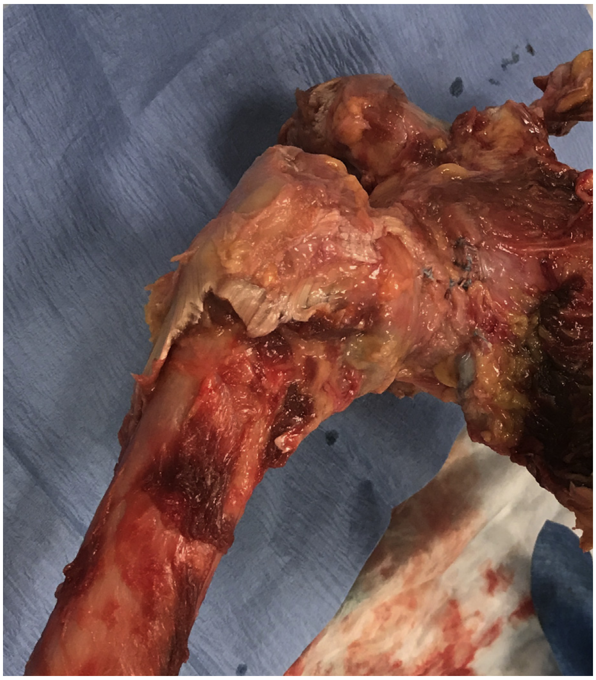

Fig 2. Plication of standard (right hip) T-capsulotomy using 3 No. 2 high-tensile strength nonabsorbable sutures using 5-mm bites on either side of the incision. The arthroscopic knot-tying technique was used with standard alternating half hitches.

same position of slight flexion and adduction, an 18-gauge spinal needle and 60-mL syringe was used to inject methylene blue—colored saline intra-articularly. Syringe resistance or the volcano method was again used as the sign for complete capsular volume fill, and the second volume measurement was recorded. The mean absolute volumes and relative volumetric reduction for each technique were recorded.

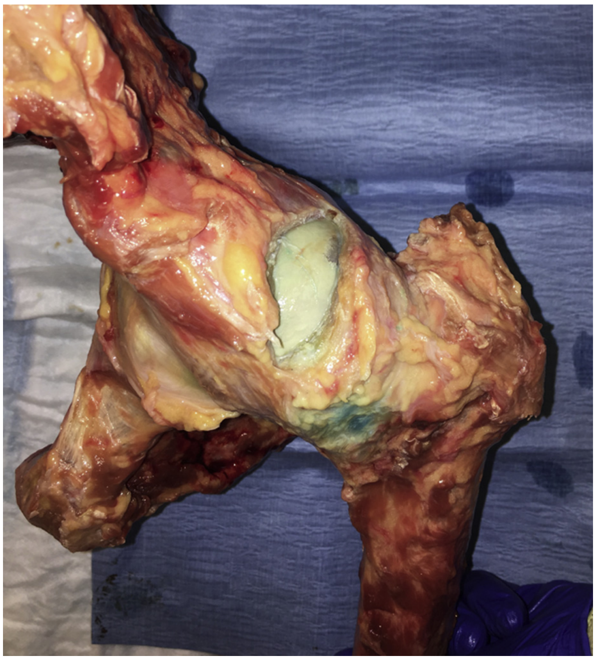

Fig 3. Standard (left hip) interportal capsulotomy: 5-cm incision from 11o'clock to 4 o'clock.

Statistical Analysis

Statistical analysis was performed using SPSS Statistics (SPSS, Chicago, IL). Descriptive statistics summarizing cadaveric demographics, capsular volumes, and relative volumetric reduction were presented as means and standard deviations or percentages where appropriate. Results were compared by using paired samples and independent *t* tests to determine statistically significant differences between techniques. For the current study, a P value of less than .05 was deemed statistically significant.

Results

Demographics

Cadaveric specimens were obtained from 6 male donors with an average age of 63 ± 16 years and average body mass index of 27.3 ± 7.0, consisting of 6 right and 6 left hemipelvi. The average age of the hips was approximately 1.2 months.

Baseline Intracapsular Volume

At baseline, there were no statistically significant differences in average intra-articular capsular volume between pair-matched specimens with intact capsule (TCP, 42.5 ± 5.1 mL; IPCS, 45.0 ± 8.6; $P = .555$) (Table 1).

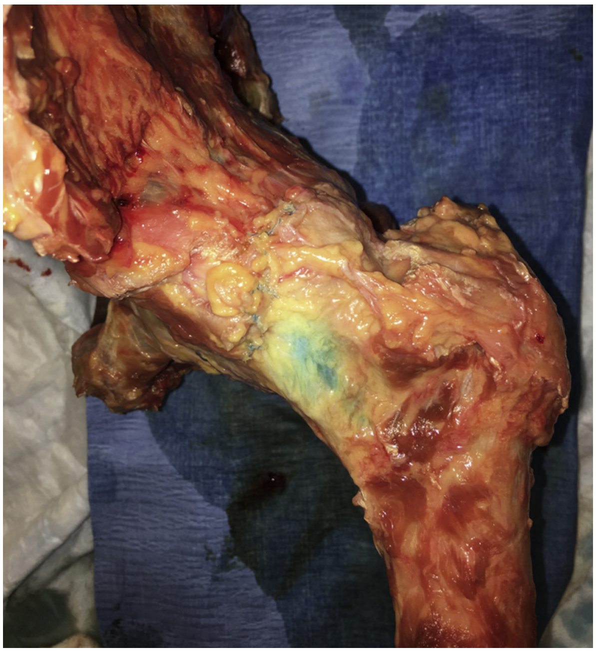

Fig 4. (Left hip) Interportal capsular shift using 5 No. 2 high-tensile strength nonabsorbable sutures placed in a medial 45° orientation from the proximal to distal capsulotomy margin using 5-mm bites on either side of the incision. The arthroscopic knot-tying technique was used with standard alternating half hitches.

Table 1. Preoperative and Postoperative Comparison of Capsular Volumes Between T-Capsulotomy Plication and Interportal Capsulotomy With Capsular Shift

	T-Capsulotomy (n = 6)	Interportal Capsulotomy (n = 6)	*P* Value
Baseline Volume (mL)	42.5 ± 5.1	45.0 ± 8.6	.555
Postoperative Volume (mL)	32.5 ± 8.0	29.4 ± 10.0	<.001
Absolute Volume Reduction (mL)	10.0 ± 3.3	15.6 ± 3.2	.014
Relative Volume Reduction (%)	24.5 ± 10.8	35.9 ± 11.3	.104

Absolute and Relative Capsular Volume Reduction

After capsulotomy and subsequent plication, both the T-capsular plication (32.5 ± 8.0 mL; $P < .001$) and interportal capsular shift groups (29.4 ± 10.0 mL; $P < .001$) demonstrated significant decreases in capsular volume, with an average reduction of 10.0 ± 3.2 mL and 15.6 ± 3.2 mL, respectively. When compared, the absolute reduction between the2 techniques were significantly different ($P = .014$) (Table 1). Relative to baseline, the interportal capsulotomy with subsequent capsular shift demonstrated greater, albeit nonsignificant, volumetric reduction when compared with T-capsulotomy with plication (IPCS, 35.9% ± 11.3% vs TCP, 24.5% ± 10.8%; $P = .104$) (Table 1). Shifts in volume for specimens that had a T-capsular plication or interportal capsular shift are depicted in Figure 5.

Discussion

The present study has revealed that both T-capsulotomy with plication and interportal capsulotomy with capsular shift result in significant decreases in capsular volume when compared with baseline. Although the interportal capsulotomy with capsular shift yielded a greater relative percentage of volumetric reduction than that of T-capsulotomy, the difference was nonsignificant.

Management of the hip capsule has become an area of intense debate within the hip arthroscopy community because consequences of surgical violation of the native capsule are becoming increasingly recognized.[2,4,10-16] Iatrogenic instability caused by transection of the iliofemoral ligament, the primary stabilizer of the hip,[9,17-19] is of utmost concern because numerous case reports of hip dislocation and subluxation after hip arthroscopy have surfaced[4,10,11,13,14,16] Even though numbers of

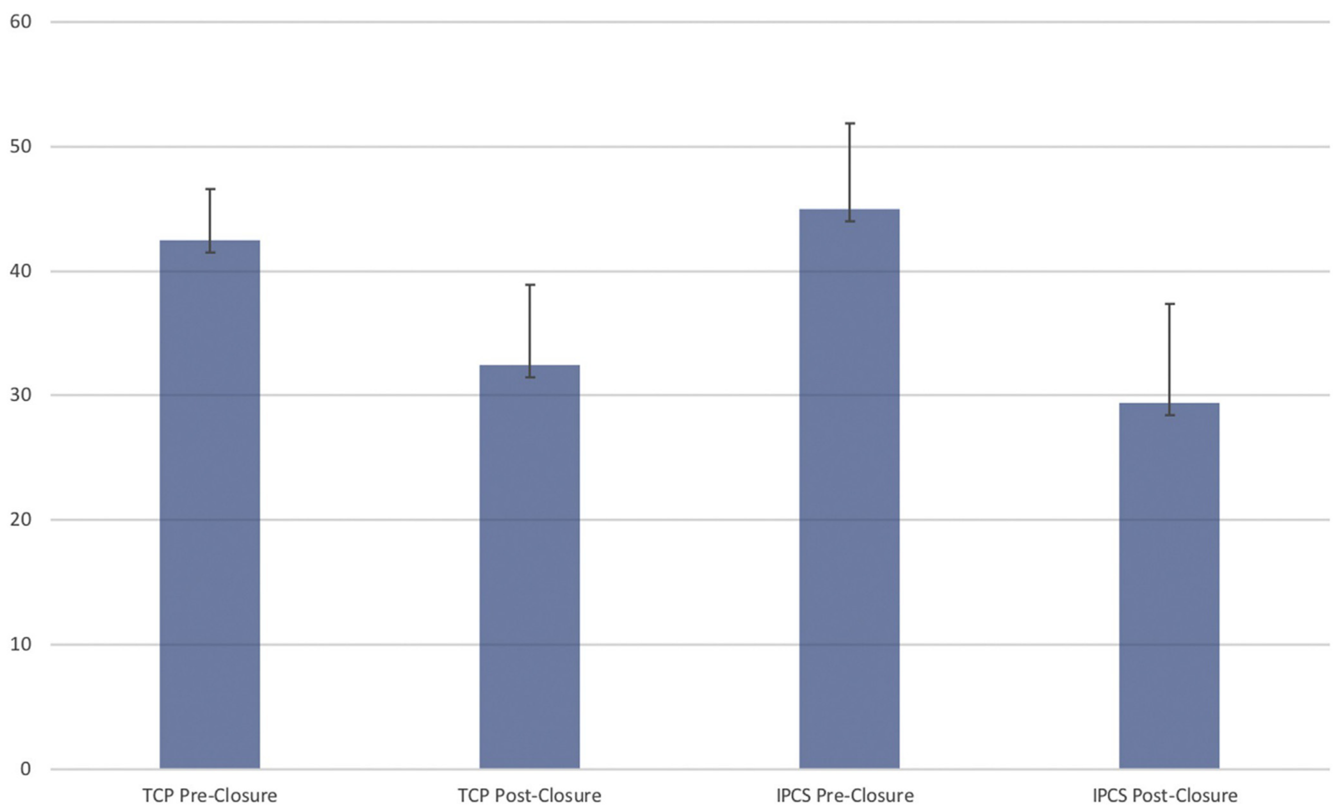

Fig 5. Capsular volumes: T-capsular plication versus interportal capsular shift before and after plication. (ICS, interportal capsular shift; TCP, T-capsulotomy plication.)

postoperative hip dislocation are thought to be underreported, the absence of macroinstability or gross dislocation events does not preclude patients who undergo hip arthroscopy from experiencing symptomatic or asymptomatic microinstability. Up to 35% of revision hip arthroscopy cases have been secondary to microinstability,[15] and structural abnormalities may subsequently develop. In a case series of 9 patients requiring revision hip arthroscopy without residual femoroacetabular impingement, McCormick et al.[20] reported 7 having capsular defects on magnetic resonance arthrography.[20] The aforementioned studies provide evidence that the capsule and its proper management play an integral role in preventing postoperative microinstability. Additionally, in a comparative, matched-pair analysis of patients who underwent T-capsulotomy with partial repair versus complete repair, Frank et al.[9] observed significant improvements at 6 months, 1 year, and 2.5 years after surgery regardless of closure technique.[9] However, those whose capsules were completely repaired reported superior sport-specific outcomes at each time point and a lower rate of revision (0%) when compared with that of the partial repair group (13%).[9] Even with evidence of excellent clinical outcomes supporting capsular closure in the general population, patients meeting specific criteria (e.g., capsular insufficiency) may require alternative capsular management.

Capsular plication, a form of repair that aims to decrease capsular volume and titrate soft tissue restraints, is warranted if patients exhibit specific overt signs of hypermobility clinically, radiographically, or arthroscopically. Briefly, clinical signs influencing the need for plication include those consistent with capsular incompetence, atraumatic instability, or increased physiologic laxity.[2] Radiographic findings include greater acetabular dysplasia (center-edge angle 20° to 24°), deficiency of bony constraint (acetabular index, stability index), or capsular redundancy on magnetic resonance arthrography, labral or ligamentum teres hypertrophy.[21] Last, arthroscopic findings include positive intraoperative vacuum sign, capsular redundancy, or laxity on manual probing, or a weakened, thin capsule.

Generalized joint laxity encompasses many factors that influence the decision to plicate rather than perform routine capsular closure. More commonly seen in populations of individuals with femoroacetabular impingement syndrome than in the general public,[22,23] patients with systemic hypermobility are at risk for labral tears requiring an arthroscopic procedure that further compromises the capsular integrity of an inherently unstable hip joint. Previous biomechanical and histologic investigations have also determined that patients with generalized joint laxity have thinner hip capsules[24] and differing compositions of collagenous protein.[25] In light of these factors, proper and meticulous capsular plication is critical for this population to reduce capsular volume, tighten the structure, and prevent instability.

The interportal capsulotomy, a transverse incision between the anterior and anterolateral portals, can vary between 2 and 6 cm in length, depending on pathology and surgeon preference. Cadaveric studies have concluded that larger interportal capsulotomies have a dose-dependent effect on joint instability, as well as distraction force.[26,27] Closure can be addressed in numerous ways,[1-4,15,28-33] but the present study involves examination of a capsular shift technique in which direct side-to-side stiches are passed in a fashion allowing larger bites on the distal capsule, passing the suture through the zona orbicularis. When tightened, the larger bites imbricate the capsule, creating increased tension in both external rotation and extension.[3,6]

For surgeons who perform T-capsulotomy, the vertical limb extending to the base of the ILFL is typically repaired first to prevent rotational instability secondary to ligamentous compromise. In a distal to proximal direction, 2 to 4 sutures are shuttled through the anterolateral portal in a direct side-to-side stitch pattern, placing desired tension on the 2 limbs.[29,30,32,33] Substantial bites are taken to adequately plicate the capsule and decrease redundant tissue. After careful placement of sutures along the ILFL, the horizontal limb is addressed with 2 to 4 sutures in the same fashion.[29,30,32,33] Results of cadaveric studies have shown that complete repair of the T-capsulotomy restores the rotational profile to the native state.[26]

The volumetric effect of capsular plication has been previously studied in a multidirectional instability model of the glenohumeral joint. Ponce et al.[34] found that a 1-cm capsular plication stitch resulted in a 10% volume reduction of the joint. The present study, however, provides quantified evidence of capsular volume reduction regardless of capsulotomy technique. Both interportal capsulotomy and T-capsulotomy with subsequent plication resulted in significant decreases in capsular volume with average reductions of 15.6 ± 3.2 mL and 10.0 ± 3.2 mL, respectively. Although it was reported that interportal capsulotomy with capsular shift and plication yielded greater volumetric reduction relative to baseline when compared with T-capsulotomy (35.9% ± 11.3% vs 24.5% ± 10.8%), the difference was nonsignificant. Furthermore, the ramifications of volumetric reduction (absolute and relative), both biomechanically and clinically, are currently unknown. Because T-capsulotomy has been popularized as a superior technique to provide visualization,[31] future investigations must determine whether the greater relative volumetric reduction after interportal capsulotomy has sufficient benefit in outcomes to outweigh the utility of T-capsulotomy in regard to exposure.

Limitations

This study has multiple limitations that may affect the applicability of its findings. Given that this is a cadaveric study and there is no critical difference in capsular volume, it was difficult to establish an a priori power analysis to ensure lack of a type II error. Additionally, we had relevant resource limitations that precluded the incorporation of further cadaveric specimens. According to post hoc analysis, the sample based on the effect size of the average volume difference is undersized, which could have resulted in type II error. Although cadaveric specimens are often required to quantitatively evaluate joint biomechanics and kinematics, they cannot replicate the in vivo nature of the dynamic hip motion. Another limitation presented is the so-called volcano method used to measure capsular volume. Although this method has been used in other studies,[7,8] it has not been properly vetted. Next, the volume was evaluated, but the effect on hip extension and rotation was not tested, and therefore, the direction of motion loss is not characterized. In addition, the cadaveric specimens were older than the general population of patients undergoing hip arthroscopy, and to the authors' knowledge, no specimens were classified as hypermobile. Similarly, we were unable to account for relative differences in capsular properties that vary with age, including those associated with generalized joint laxity. Finally, it is impossible to arthroscopically replicate the precise nature of the capsulotomy and plication presented in this study. On the basis of these limitations and the bench nature of this study, we cannot make any conclusions regarding the clinical relevance of volumetric reduction with capsular plication.

Conclusions

Both T-capsular plication and interportal capsular shift produce statistically significant reductions in overall hip capsular volume. Although the interportal capsular shift may generate modestly higher degrees of capsular reduction, the comparative biomechanical repercussions of each technique are not currently known.

References

1. Boykin RE, Anz AW, Bushnell BD, Kocher MS, Stubbs AJ, Philippon MJ. Hip instability. *J Am Acad Orthop Surg* 2011;19:340-349.
2. Shu B, Safran MR. Hip instability: Anatomic and clinical considerations of traumatic and atraumatic instability. *Clin Sports Med* 2011;30:349-367.
3. Domb BG, Philippon MJ, Giordano BD. Arthroscopic capsulotomy, capsular repair, and capsular plication of the hip: Relation to atraumatic instability. *Arthroscopy* 2013;29:162-173.
4. Ranawat AS, McClincy M, Sekiya JK. Anterior dislocation of the hip after arthroscopy in a patient with capsular laxity of the hip. A case report. *J Bone Joint Surg Am* 2009;91:192-197.
5. Han S, Alexander JW, Thomas VS, et al. Does capsular laxity lead to microinstability of the native hip? *Am J Sports Med* 2018;46:1315-1323.
6. Levy DM, Grzybowski J, Salata MJ, Mather RC III, Aoki SK, Nho SJ. Capsular plication for treatment of iatrogenic hip instability. *Arthrosc Tech* 2015;4: e625-e630.
7. Lubiatowski P, Ogrodowicz P, Wojtaszek M, Breborowicz M, Dlugosz J, Romanowski L. Arthroscopic capsular shift technique and volume reduction. *Eur J Orthop Surg Traumatol* 2012;22:437-441.
8. Yen CH, Leung HB, Tse PY. Effects of hip joint position and intra-capsular volume on hip joint intra-capsular pressure: A human cadaveric model. *J Orthop Surg Res* 2009;4:8.
9. Frank RM, Lee S, Bush-Joseph CA, Kelly BT, Salata MJ, Nho SJ. Improved outcomes after hip arthroscopic surgery in patients undergoing T-capsulotomy with complete repair versus partial repair for femoroacetabular impingement: A comparative matched-pair analysis. *Am J Sports Med* 2014;42:2634-2642.
10. Benali Y, Katthagen BD. Hip subluxation as a complication of arthroscopic debridement. *Arthroscopy* 2009;25: 405-407.
11. Dierckman BD, Guanche CA. Anterior hip capsuloligamentous reconstruction for recurrent instability after hip arthroscopy. *Am J Orthop (Belle Mead NJ)* 2014;43: E319-E323.
12. 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.
13. Matsuda DK. Acute iatrogenic dislocation following hip impingement arthroscopic surgery. *Arthroscopy* 2009;25: 400-404.
14. Mei-Dan O, McConkey MO, Brick M. Catastrophic failure of hip arthroscopy due to iatrogenic instability: Can partial division of the ligamentum teres and iliofemoral ligament cause subluxation? *Arthroscopy* 2012;28:440-445.
15. Philippon MJ, Schenker ML, Briggs KK, Kuppersmith DA, Maxwell RB, Stubbs AJ. Revision hip arthroscopy. *Am J Sports Med* 2007;35:1918-1921.
16. Sansone M, Ahlden M, Jonasson P, Sward L, Eriksson T, Karlsson J. Total dislocation of the hip joint after arthroscopy and ileopsoas tenotomy. *Knee Surg Sports Traumatol Arthrosc* 2013;21:420-423.
17. Martin HD, Savage A, Braly BA, Palmer IJ, Beall DP, Kelly B. The function of the hip capsular ligaments: A quantitative report. *Arthroscopy* 2008;24:188-195.
18. Myers CA, Register BC, Lertwanich P, et al. Role of the acetabular labrum and the iliofemoral ligament in hip stability: An in vitro biplane fluoroscopy study. *Am J Sports Med* 2011;39:85S-91S (suppl).
19. Philippon MJ, Michalski MP, Campbell KJ, et al. An anatomical study of the acetabulum with clinical applications to hip arthroscopy. *J Bone Joint Surg Am* 2014;96: 1673-1682.
20. McCormick F, Slikker W III, Harris JD, et al. Evidence of capsular defect following hip arthroscopy. *Knee Surg Sports Traumatol Arthrosc* 2014;22:902-905.
21. Harris JD, Gerrie BJ, Varner KE, Lintner DM, McCulloch PC. Radiographic prevalence of dysplasia, cam,

and pincer deformities in elite ballet. *Am J Sports Med* 2016;44:20-27.

22. Naal FD, Hatzung G, Muller A, Impellizzeri F, Leunig M. Validation of a self-reported Beighton score to assess hypermobility in patients with femoroacetabular impingement. *Int Orthop* 2014;38:2245-2250.
23. Russek LN, Errico DM. Prevalence, injury rate and, symptom frequency in generalized joint laxity and joint hypermobility syndrome in a "healthy" college population. *Clin Rheumatol* 2016;35:1029-1039.
24. Devitt BM, Smith BN, Stapf R, Tacey M, O'Donnell JM. Generalized joint hypermobility is predictive of hip capsular thickness. *Orthop J Sports Med* 2017;5: 2325967117701882.
25. Rodeo SA, Suzuki K, Yamauchi M, Bhargava M, Warren RF. Analysis of collagen and elastic fibers in shoulder capsule in patients with shoulder instability. *Am J Sports Med* 1998;26:634-643.
26. Abrams GD, Hart MA, Takami K, et al. Biomechanical evaluation of capsulotomy, capsulectomy, and capsular repair on hip rotation. *Arthroscopy* 2015;31:1511-1517.
27. Wuerz TH, Song SH, Grzybowski JS, et al. Capsulotomy size affects hip joint kinematic stability. *Arthroscopy* 2016;32:1571-1580.
28. Asopa V, Singh PJ. The intracapsular atraumatic arthroscopic technique for closure of the hip capsule. *Arthrosc Tech* 2014;3:e245-e247.
29. Bedi A, Galano G, Walsh C, Kelly BT. Capsular management during hip arthroscopy: From femoroacetabular impingement to instability. *Arthroscopy* 2011;27:1720-1731.
30. Camp CL, Reardon PJ, Levy BA, Krych AJ. A simple technique for capsular repair after hip arthroscopy. *Arthrosc Tech* 2015;4:e737-e740.
31. Camp CL, Reardon PJ, Levy BA, Krych AJ. Creating and closing the T-capsulotomy for improved visualization during arthroscopic treatment of femoroacetabular impingement. *Arthrosc Tech* 2015;4:e731-e735.
32. Chow RM, Engasser WM, Krych AJ, Levy BA. Arthroscopic capsular repair in the treatment of femoroacetabular impingement. *Arthrosc Tech* 2014;3:e27-e30.
33. Harris JD, Slikker W 3rd, Gupta AK, McCormick FM, Nho SJ. Routine complete capsular closure during hip arthroscopy. *Arthrosc Tech* 2013;2:e89-e94.
34. Ponce BA, Rosenzweig SD, Thompson KJ, Tokish J. Sequential volume reduction with capsular plications: Relationship between cumulative size of plications and volumetric reduction for multidirectional instability of the shoulder. *Am J Sports Med* 2011;39:526-531.