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COMPARISON OF PREOPERATIVE MAGNETIC RESONANCE IMAGING VS INTRAOPERATIVE LABRAL HEIGHT IN REVISION HIP ARTHROSCOPY

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DISCLOSURES

- SMC, HKD have nothing to disclose
- JJR is a consultant for Smith & Nephew
- JJE is a consultant for Johnson & Johnson and Depuy Mitek Sports Medicine
- MJP has the following disclosures:
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  - **Board Member:** Vail Health Services, Vail Valley Surgery Center-Governing, ISHA, Orthopedics Today- Advisory, AJSM- Editorial
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BACKGROUND

- Labra that are too severely damaged or deficient in size may not be effectively repaired given their vulnerability to suture cutout, pathologic eversion, and/or inability to recreate the suction seal mechanism

- Alternative surgical strategies for addressing deficient or poor-quality labra, including labral reconstruction or augmentation
  - Improvements in hip joint biomechanics similar to the native state
  - Good functional outcomes and survivorship with careful patient selection

Knee Surg Sports Traumatol Arthrosc. 2014 Apr;22(4):722-9. doi: 10.1007/s00167-014-2874-z. Epub 2014 Feb 12.

The hip fluid seal--Part I: the effect of an acetabular labral tear, repair, resection, and reconstruction on hip fluid pressurization.

Philippon MJ[1], Nepple JJ, Campbell KJ, Dornan GJ, Jansson KS, LaPrade RF, Wijdicks CA.

Am J Sports Med. 2015 Jan;43(1):98-104. doi: 10.1177/0363546514553089. Epub 2014 Oct 31.

Labral reconstruction with iliotibial band autografts and semitendinosus allografts improves hip joint contact area and contact pressure: an in vitro analysis.

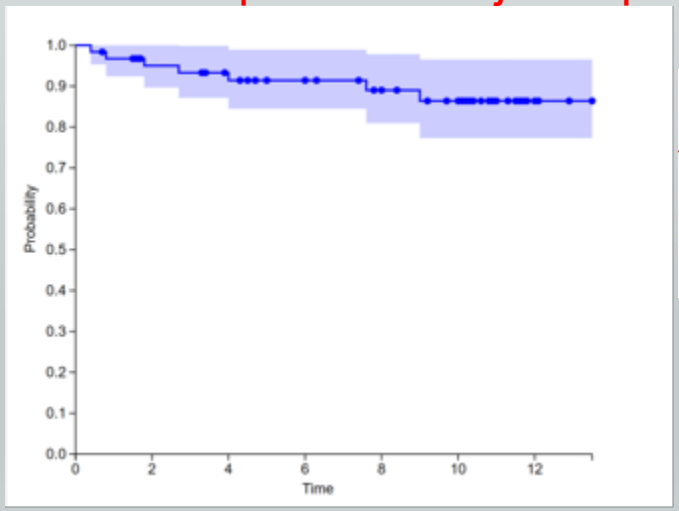
Lee S[1], Wuerz TH[1], Shewman E[1], McCormick FM[2], Salata MJ[3], Philippon MJ[4], Nho SJ[5].

> Am J Sports Med. 2020 Sep;48(11):2726-2732. doi: 10.1177/0363546520941855. Epub 2020 Aug 7.

The Hip Suction Seal, Part I: The Role of Acetabular Labral Height on Hip Distractive Stability

Hunter W Storaci [1], Hajime Utsunomiya [1], Bryson R Kemler [1], Samuel I Rosenberg [1], Grant J Dornan [1], Alex W Brady [1], Marc J Philippon [1 2]

Survivorship for >2mm joint space



JB&JS

Acetabular **Labral Reconstruction** with Iliotibial Band Autograft: Outcome and Survivorship at a Minimum **10-Year** Follow-up.

Philippon MJ, Arner JW, Crawford MD, Bolia IK, Briggs KK.

- 82 pts
- Overall survivorship: 5 yr=70%, 10 yr=61%
- Mean survival: 9 yrs (95% CI 7.5-10)
- Significant improvement in HOS-ADL, HOS-Sport

BACKGROUND

- **The ability to accurately identify patients preoperatively with deficient labra could be valuable for patient counseling, surgical preparation, and determine if a patient should seek consultation with a hip arthroscopist more experienced in complex revision surgery**

- **The validity of labral width measurement on advanced imaging as compared to intraoperative arthroscopic measurement has been studied in the case of primary arthroscopy with mixed results**

- **There is a paucity of literature on the ability to predict labral size intraoperatively from preoperative magnetic resonance imaging in revision hip arthroscopy**

Preoperative Magnetic Resonance Imaging Predicts Intraoperative **Labral Width** at the 9-O'clock and 12-O'clock Positions in Primary Hip Arthroscopy.

Comfort SM, Ruzbarsky JJ, Ernat JE, Philippon MJ.

Arthroscopy, Sports Medicine, and Rehabilitation

	Intrarater ICC (95% CI)		Inter-rater ICC (95% CI)
	Surgeon 1	Surgeon 2	
3-O'clock position	0.892 (0.772-0.943)	0.769 (0.610-0.863)	0.714 (0.515-0.832)
12-O'clock position	0.873 (0.697-0.938)	0.791 (0.647-0.876)	0.820 (0.682-0.896)
9-O'clock position	0.828 (0.705-0.900)	0.412 (0.009-0.651)	0.759 (0.591-0.858)

Location	Sensitivity, %	Positive Predictive Value, %
3-O'clock position	87	92
12-O'clock position	79	89
9-O'clock position	60	94

Validity of Magnetic Resonance Imaging Measurement of Hip **Labral Width** Compared With Intraoperative Assessment.

Kaplan DJ, Samim M, Burke CJ, Meislin RJ, Youm T.

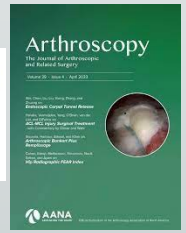


Table 5. Labrum Sizes and ICC Values Based on Intraoperative Assessment and Various Modalities of Radiologic Imaging

	Measurements (mm)		ICC			
MRI (all)	Intraoperative	MR Total	Intraoperative vs MRI	*P* Value	Radiologist Interrater	*P* Value
Psoas-U (3 o'clock)	5.8 (2-8; ±1.4)	6.3 (2-10; ±1.5)	0.82	<.001	0.88	<.001
Indirect Rectus (11:30)	6.3 (2-10; ±1.5)	6.7 (3-10; ±1.4)	0.78	<.001	0.93	<.001
Point Halfway Between (1:30)	6.0 (2-9; ±1.5)	6.1 (2-9; ±1.6)	0.84	<.001	0.88	<.001

	Measurements (mm)		ICC			
MRI Only (no MRA)	Intraoperative	MRI Only	Intraoperative vs MRI	*P* Value	Radiologist Interrater	*P* Value
Psoas-U (3 o'clock)	5.9 (2-8; ±1.5)	6.6 (3-10; ±1.4)	0.79	<.001	0.88	<.001
Indirect Rectus (11:30)	6.2 (2-9; ±1.5)	6.8 (4-10; ±1.3)	0.73	<.001	0.90	<.001
Point Halfway Between	5.9 (2-8; ±1.5)	6.2 (2-9; ±1.7)	0.86	<.001	0.88	<.001

	Measurements (mm)		ICC			
MRI 1.5T (no MRA)	Intraoperative	MRI 1.5T	Intraoperative vs MRI	*P* Value	Radiologist Interrater	*P* Value
Psoas-U (3 o'clock)	5.6 (2-9; ±1.6)	6.5 (3-10; ±1.7)	0.80	<.001	0.92	<.001
Indirect Rectus (11:30)	6.3 (2-9; ±1.7)	6.9 (4-10; ±1.5)	0.77	.001	0.92	<.001
Point Halfway Between	5.8 (2-8; ±2.0)	6.0 (2-9; ±1.7)	0.86	<.001	0.88	<.001

	Measurements (mm)		ICC			
3T MRI (no MRA)	Intraoperative	MR Total	Intraoperative vs MRI	P Value	Radiologist Interrater	P Value
Psoas-U (3 o'clock)	6.3 (4-8; ±1.2)	6.9 (4-8; ±0.9)	0.75	.004	0.68	.027
Indirect Rectus (11:30)	6.1 (3-8; ±1.3)	6.6 (3-8; ±1.1)	0.63	.032	0.84	.001
Point Halfway Between (1:30)	6.2 (3-8; ±1.3)	6.4 (4-9; ±1.6)	0.87	<.001	0.88	<.001

	Measurements (mm)		ICC			
3T MRA	Intraoperative	MR Total	Intraoperative vs MRI	*P* Value	Radiologist Interrater	*P* Value
Psoas-U (3 o'clock)	5.6 (3-8; ±1.1)	5.5 (2-8; ±1.3)	0.89	<.001	0.82	.001
Indirect rectus (11:30)	6.4 (4-10; ±1.6)	6.7 (3-9; ±1.5)	0.88	<.001	0.98	<.001
Point halfway between (1:30)	6.1 (3-8; ±1.1)	5.9 (3-8; ±1.4)	0.77	.004	0.89	<.001

NOTE: Range; ±standard deviation. ICC, interclass correlation; MRA, magnetic resonance angiography; MRI, magnetic resonance imaging,

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PURPOSE

To compare magnetic resonance imaging (MRI) measured labral height with values obtained intraoperatively in revision hip arthroscopy

METHODS

Study Design: Case series

Patient Selection:

- Underwent revision hip arthroscopy with the senior surgeon (M.J.P.) between January 2008 and December 2015
- Available preoperative MRI imaging and records of intraoperative labral height measurements

Exclusion Criteria:

- Missing or insufficient MRI imaging or intraoperative labral height measurements

Data Collection

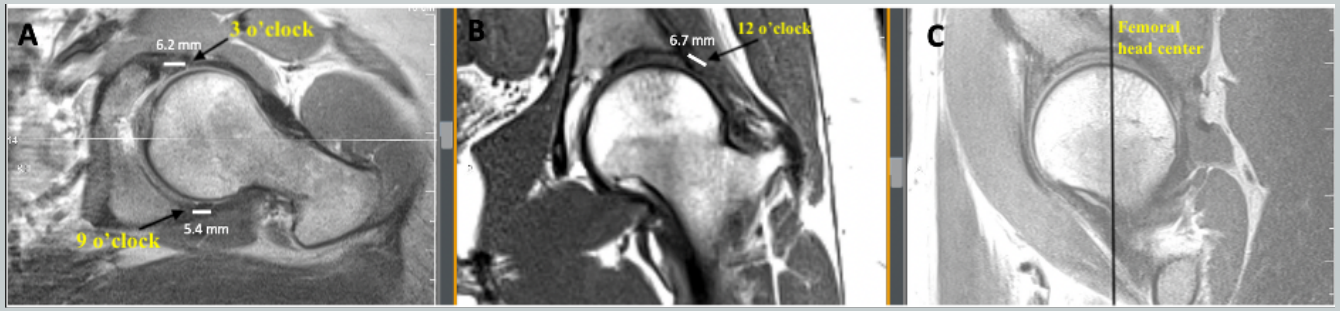
- Demographics (Age, gender, BMI)
- Intraoperative findings and procedures

A priori power analysis determined 58 patients required to detect a mean difference of 1 mm ± 2.65 in labral height

Study Measurements

Imaging Evaluation:

- MRI studies were performed at the host institution and uploaded into the picture archiving and communication system (PACS)
- Retrospectively, two orthopedic surgeons in sports medicine fellowship independently reviewed and made the labral height measurements on proton density sequences
- Measurements were made at 3 standardized locations using the clockface method:
  - 3 o'clock position – axial sequences
  - 12 o'clock position – coronal sequences
  - 9 o'clock position – axial sequences
- Each surgeon made the measurements twice 4 weeks apart
  - Measurements were averaged for each surgeon and randomly assigned at the 3 locations for all patients



Intraoperative Measurement:

- Labral height measurements were made by the senior surgeon (M.J.P.) using a standardized measuring probe
- Measurements were made at the same 3 standardized locations to the nearest millimeter and prospectively recorded on a research form

RESULTS

- 58 patients included
  - 31 males, 27 females with mean age of 28.7 ± 9.8
  - 56/58 (97%) had noncontrast 3 Tesla (3T) MRI performed at host institution with same imaging protocol.
- Revision surgery at mean 2.9 $\pm$ 2.8 years after a median of 1 (range: 1 to 3) prior surgeries.
  - Thirty-eight (66%) patients had labral repair, 12 (21%) patients had labral debridement, and 8 (14%) patients had no labral treatment during previous surgery
- Surgeon 1 had good ICCs and Surgeon 2 had fair to excellent ICCs
- Inter-rater reliability between the two surgeons for MRI measurements were poor to good

Location	Intra-rater ICC [95% CI] Surgeon 1	Surgeon 2	Inter-rater ICC [95% CI]
3 o'clock position	.612 [.229-.780]	.716 [.522-.832]	.714 [.339-.772]
12 o'clock position	.665 [.066-.852]	.828 [.710-.898]	.820 [.155-.703]
9 o'clock position	.632 [.364-.785]	.437 [.052-.666]	.759 [-.286-.438]

RESULTS

MRI versus Intraoperative Measurements

- Average labral height was larger on MRI versus intraoperative at the 3 and 12 o'clock locations with the mean differences statistically significant
- The intraoperative measurement was larger than the MRI measurement at the 9 o'clock position (34/58 (59%)) and the mean differences were nonsignificant (p=.11)
- When the MRI measurements were rounded to whole numbers, there was no significant difference in the mean differences or statistical significance between MRI and intraoperative measurements

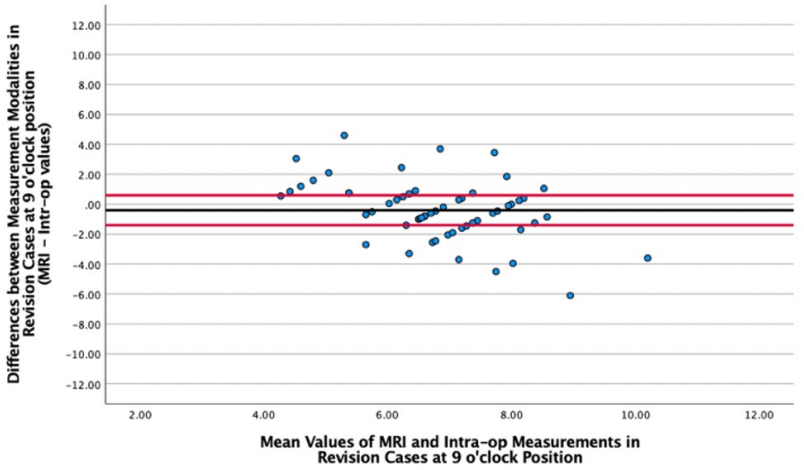
	MRI measurement, mean ± SD	Intraoperative measurement, mean ± SD	Mean Difference ± SD	P value, Paired Sample T test
Total				
***3 o'clock position**	7.4 ± 1.2	6.7 ± 2.1	.70 ± 2.4	.03
***12 o'clock position**	7.5 ± 1.4	6.5 ± 2.5	1.0 ± 2.9	.01
9 o'clock position	6.6 ± 1.2	7.0 ± 1.9	-.43 ± 2.0	.11
Male subgroup				
3 o'clock position	7.8 ± .99	6.5 ± 2.3	1.3 ± 2.6	.02
12 o'clock position	8.1 ± 1.2	6.3 ± 2.7	1.8 ± 3.0	.004
9 o'clock position	6.9 ± 1.1	7.1 ± 1.9	-.19 ± 2.0	.63
Female subgroup				
3 o'clock position	7.1 ± 1.3	6.9 ± 2.0	.17 ± 2.1	.66
12 o'clock position	6.9 ± 1.3	6.7 ± 2.4	.25 ± 2.6	.60
9 o'clock position	6.3 ± 1.2	7.0 ± 1.9	-.63 ± 2.0	.09

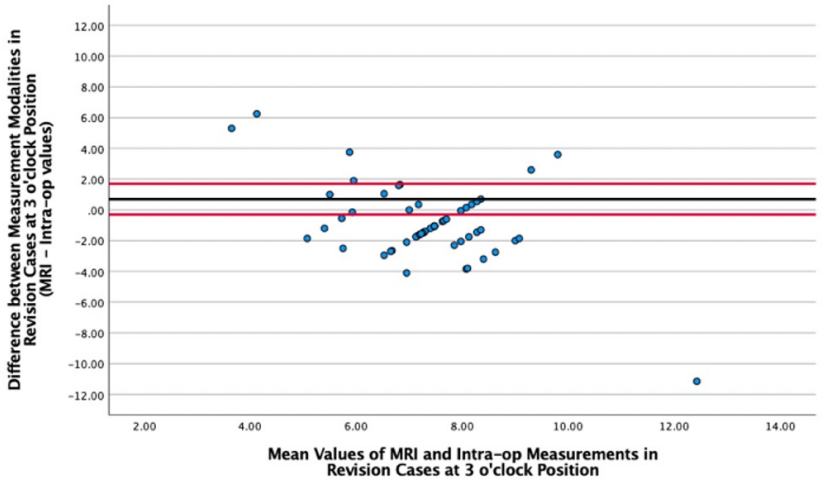
RESULTS

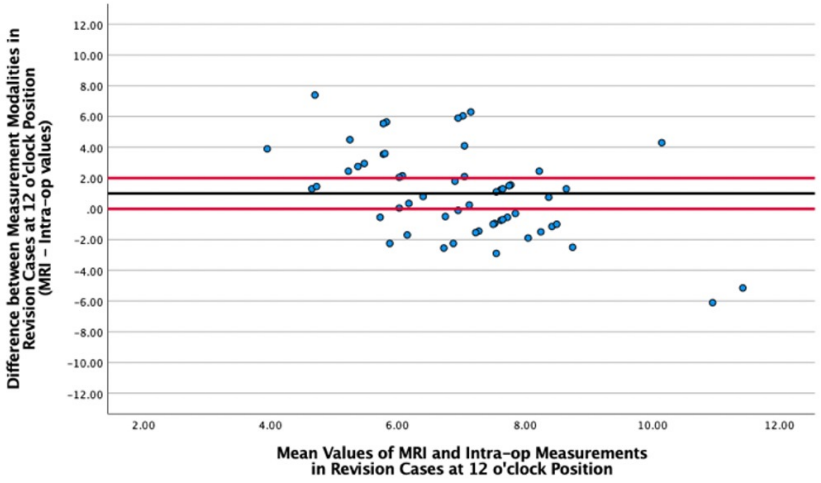
Location	Sensitivity	Positive Predictive Value (PPV)	Diagnostic Accuracy
3 o'clock	88%	72%	67%
12 o'clock	87%	68%	64%
9 o'clock	77%	88%	72%

- The sensitivity, positive predictive value, and diagnostic accuracy for using MRI measurement to identify labral widths <6 or ≥6 mm

RESULTS







- Bland Altman plots were built to demonstrate the differences in measurement modalities and the magnitude of the difference
- Level of agreement within 1 mm of the mean difference was distributed similarly at each measurement location with the majority of mean difference falling outside of 1 mm of the mean labral width

CONCLUSION

- This study demonstrated varied ICCs between surgeons and among the 3 standard measurement positions when determining labral width by MRI.
- The MRI measurements were significantly larger than intraoperative measurements at the 3 and 12 o'clock positions. However, when rounded to whole numbers, there was no significant difference between MRI and intraoperative measurements.
- While there was high sensitivity in detection of labral width >6 mm, the positive predictive value and diagnostic accuracy were lower.
- MRI measurement of the labrum has potential utility in surgical planning in the revision setting; however, the variability in results shows the need for further validation and fine-tuning of the measurement methodology with input from musculoskeletal radiologists.

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1. Storaci HW, Utsunomiya H, Kemler BR, et al. The Hip Suction Seal, Part I: The Role of Acetabular Labral Height on Hip Distractive Stability. *Am J Sports Med*. 2020;48(11):2726-2732
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