Microbial Colonization of Capsular Traction Sutures in Hip Arthroscopic Surgery

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Background: A common practice in hip arthroscopic surgery is the utilization of capsular traction sutures that can be incorporated into the capsular repair site at the end of the procedure, potentially seeding the hip joint with colonized suture material.

Purpose: To investigate the rate of the microbial colonization of capsular traction sutures used during hip arthroscopic surgery and to identify patient-associated risk factors for this microbial colonization.

Study Design: Cross-sectional study; Level of evidence, 3.

Methods: A total of 50 consecutive patients who underwent hip arthroscopic surgery with a single surgeon were enrolled. There were 4 braided nonabsorbable sutures utilized for capsular traction during each hip arthroscopic procedure. These 4 traction sutures and 1 control suture were submitted for aerobic and nonaerobic cultures. Cultures were held for 21 days. Demographic information was collected, such as age, sex, and body mass index. All variables underwent bivariate analysis, and variables with a *P* value $<.1$ underwent further analysis in a multivariate logistic regression model.

Results: One of 200 experimental traction sutures and 1 of 50 control sutures had a positive culture. *Proteus mirabilis* and *Citrobacter koseri* were isolated in both these positive experimental and control cultures from the same patient. Age and traction time were not significantly associated with positive cultures. The rate of microbial colonization was 0.5%.

Conclusion: The rate of the microbial colonization of capsular traction sutures used in hip arthroscopic surgery was low, and no patient-associated risk factors were identified for microbial colonization. Capsular traction sutures used in hip arthroscopic surgery were not a significant potential source of microbial contamination. Based on these results, capsular traction sutures can be incorporated in capsular closure with a low risk of seeding the hip joint with microbial contaminants.

Keywords: FAI; microbial colonization; capsular traction suture; hip arthroscopic surgery

Minimizing the risk of intraoperative sources of an infection is paramount during surgical procedures. A common practice in hip arthroscopic surgery is the utilization of traction sutures after capsulotomy early in the surgical procedure to improve visualization. Capsular traction sutures can be incorporated in capsular repair at the end of the procedure, thus potentially seeding the hip joint with colonized suture material.

The incidence of infections after hip arthroscopic surgery has been reported to be between 0% and 1.2%.[§] Multiple independent risk factors have been identified including smoking, obesity, inflammatory arthritis, chronic kidney disease, and preoperative joint injections.[23] Although septic arthritis after hip arthroscopic surgery is relatively uncommon, the potential for significant morbidity, such as irreversible chondral damage,[17,21] warrants an investigation of all potential endogenous and exogenous sources of an infection.

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[§]References 4, 6, 9, 10, 13-16, 18, 19, 22, 23.

While prior studies have looked at risk factors for an infection after hip arthroscopic surgery, the use of capsular traction sutures has not been evaluated. Roach et al[20] evaluated the rate of the microbial colonization of subscapularis tagging sutures in shoulder arthroplasty. Their study demonstrated the statistically significant colonization of both tagging and control sutures (24% vs 32%, respectively).

The purposes of the present study were to investigate the prevalence of the microbial colonization of capsular traction sutures used during hip arthroscopic surgery and to identify potential associated risk factors for this microbial colonization. We hypothesized that (1) the prevalence of the microbial colonization of capsular traction sutures used in hip arthroscopic surgery would be low and (2) patient-associated risk factors for microbial colonization would be identified such as body mass index or surgery time.

METHODS

Patient Selection

A total of 50 consecutive patients who underwent hip arthroscopic surgery with a single surgeon (M.B.B.) were reviewed at our institution between August 2020 and July 2021. Institutional review board approval was obtained. The sample size was based on a prior study performed by Roach et al.[20] Patients who underwent primary or revision hip arthroscopic surgery including labral debridement, labral repair, labral reconstruction, and associated femoral and/or acetabular osteoplasty were included. Patients who underwent nonarthroscopic but endoscopic hip procedures, such as gluteus medius repair and hamstring tendon repair, were excluded.

Demographic information was collected including age, sex, body mass index, comorbidities, and tobacco use. Diagnosis traction time, and intraoperative procedures were also recorded and reported.

Surgical Technique and Data Collection

Patients were positioned supine on a postless hip arthroscopic surgery table (Pivot Guardian; Stryker) and were prepared and draped according to the institution's standard protocol. The preparation solution consisted of 2% chlorhexidine gluconate and 70% isopropyl alcohol (ChloraPrep; CareFusion). The hip was draped with an adhesive drape (Ioban Antimicrobial Incise Drape; 3M). Weight-based intravenous Ancef (Hikma pharmaceuticals)was given before the incision. Standard anterolateral and midanterior portals were established. Interportal capsulotomy was performed, and 2 ultra–high molecular weight polyethylene capsular traction sutures (1.4-mm XBraid TT Black/White; Stryker) were introduced with the use of a suture-passing device (InJector II; Stryker) in each portal (4 total). The sutures were then placed on traction and secured with a surgical clamp over the skin. A separate nonabsorbable, braided suture was placed in a sterile container by the surgical technician with clean, sterile gloves; this served as our control suture. The control suture was not handled during the procedure and was left open in the operating room environment. The appropriately indicated surgical procedure was then undertaken. At the end of the arthroscopic procedure, one end of the traction sutures was cut at the skin and then pulled out from the other end; the 4 traction sutures and 1 control suture were placed in separate sterile containers (BBL Port-A-Cul; Becton Dickinson) on a sterile back table and were submitted to our institution's microbiology laboratory for aerobic and nonaerobic cultures.

Microbiology Procedure

Sutures were prepared and cultured as described by Roach et al.[20] Each suture was removed from the BBL Port-A-Cul container in a biosafety level 2 cabinet using sterile forceps and carefully transferred to a wide-mouth 50-mL sterile conical tube to which 32 mL of thioglycolate broth enriched with vitamin K and hemin (BBL 221787; Becton Dickinson) was added. The sample was then vortexed for 15 seconds and incubated at 37°C in ambient air for 21 days. The tubes were examined daily for visible evidence of growth. Visually positive samples were subcultured immediately, whereas samples with no visible growth were subcultured weekly until termination. All specimens were subcultured aerobically (trypticase soy agar with 5% sheep blood, Columbia agar with colistin and nalidixic acid, and chocolate and MacConkey agar) and anaerobically (Brucella agar with vitamin K and hemin and phenylethyl alcohol agar). Aerobic plates were held for 4 days, whereas anaerobic plates were held for 7 to 10 days. All organisms were identified to the genus and/or species level using matrix-assisted laser desorption/ionization time-of-flight mass spectrometry with the Vitek 2 system (bioMérieux) or conventional methods.

Statistical Analysis

All bivariate statistical analyses were conducted using Excel with the Real Statistics add-in package (Microsoft), SISA (Simple Interactive Statistical Analysis) and R (Version 4.1.0; R Foundation for Statistical Computing). Before the study, statistical significance was established as a P value $<.05$. Continuous data were analyzed for significance using the Crawford-Howell modified t test.[8] Categorical data were analyzed for statistical significance using the Fisher test.

All variables in the bivariate analysis with a P value of $<.1$ were evaluated using a logistic regression model.[3] Continuous variables were analyzed using linearity between the continuous predictors and the logarithmic odds of having a positive microbial culture via restricted cubic splines and linear transformations where needed,[7] and odds ratios with 95% CIs were calculated for all variables entered into the logistic regression model. The model was evaluated and graded for accuracy by determining the mean percentage of patients with a positive microbial culture correctly classified and the mean percentage of patients with a negative microbial culture correctly classified.

TABLE 1
Patient Demographic, Diagnostic, and Surgical Characteristics (n = 50)[a]

	Value
Age, y	29.6 ± 9.1
Body mass index, kg/m^2	25.0 ± 3.1
Sex	
Male	35 (70.0)
Female	15 (30.0)
Traction time, min	38.0 ± 16.4
Tobacco use	
Previously	3 (6.0)
Never	47 (94.0)
Comorbidities	
Ehlers-Danlos syndrome	1 (2.0)
Hypothyroidism	1 (2.0)
Workers' compensation	2 (4.0)
Revision surgery	8 (16.0)
Diagnosis	
FAIS/acetabular delamination	2 (4.0)
FAIS/labral tear	42 (84.0)
FAIS/labral tear/os acetabuli	2 (4.0)
Failed labral repair	3 (6.0)
Labral tear/internal snapping	1 (2.0)
Surgical procedure	
Femoroplasty	49 (98.0)
Labral treatment	
Repair	42 (84.0)
Selective debridement	3 (6.0)
Reconstruction	4 (8.0)
None	1 (2.0)
Acetabular cartilage procedure with BioCartilage	3 (6.0)
Acetabular microfracture	2 (4.0)
Iliopsoas lengthening	1 (2.0)

[a]Data are reported as mean ± SD or n (%). FAIS, femoroacetabular impingement syndrome.

RESULTS

Included in the study were 50 patients, with a mean age of 29.6 ± 9.1 years and of whom 15 (30.0%) were female. The mean traction time during hip arthroscopic surgery was 38.0 ± 16.4 minutes. Patient demographic, diagnostic, and surgical data are listed in Table 1.

One of 50 control cultures and 1 of 200 experimental cultures tested positive for the presence of bacteria. The positive control and experimental cultures were from the same patient, and both grew *Proteus mirabilis* and *Citrobacter koseri*. There was no significant difference in the colonization rate between the positive control and experimental cultures ($P > .999$). The rate of microbial colonization was 0.5% (Table 2).

The positive and negative cultures were compared and had a similar proportion of femoroplasty (100.0% vs 98.0%, respectively; $P > .999$). While positive cultures trended toward a higher age (42.0 vs 29.4 ± 9.0 years, respectively; $P = .086$) and traction time (62.0 vs 37.5 ± 16.2 minutes, respectively; $P = .070$) versus negative cultures, there was no significant difference between the 2 groups (Table 3).

TABLE 2
Results of Microbial Culture

	n (%)
Capsular traction suture	
Proteus mirabilis	1 (0.5)
Citrobacter koseri	1 (0.5)
Control suture	
Proteus mirabilis	1 (2.0)
Citrobacter koseri	1 (2.0)

Multiple logistic regression was performed for variables that underwent bivariate analysis with P values <.1: age and traction time. Logistic regression found that no variables had a significant association with a positive microbial culture (Table 4).

DISCUSSION

The main finding of the present investigation was that the rate of the microbial colonization of capsular traction sutures used in hip arthroscopic surgery was low. Furthermore, no patient-associated risk factors were identified for the microbial colonization of capsular traction sutures. Our hypothesis that the prevalence of the microbial colonization of capsular traction sutures used in hip arthroscopic surgery would be low was supported. No patient-associated risk factors for the microbial colonization of capsular traction sutures were identified, also confirming our hypothesis.

A surgical site infection (SSI) is a potentially devastating complication with the potential for prolonged morbidity. Both intrinsic and extrinsic risk factors exist for an SSI. While some intrinsic factors can be corrected before a surgical intervention (smoking cessation, weight loss, and surgical preparation to sterilize skin flora), others are nonmodifiable (diabetes and inflammatory arthritis). Extrinsic sources such as operating room traffic, laminar air flow, and inanimate objects are modifiable, which, when properly addressed, have been shown to decrease SSIs.[1,11] Recognizing these potential sources and appropriately addressing them are critical to preventing SSIs.

While there are no other studies looking at the microbial colonization of traction sutures in hip arthroscopic surgery, Roach et al[20] demonstrated subscapularis tagging sutures as a potential source of infections in shoulder arthroplasty and recommended exchanging them before repair of the subscapularis. In their study, they found a statistically significant rate of colonization with both tagging and control sutures (24% vs 32%, respectively), with many of the cultures growing *Cutibacterium acnes*. Risk factors included active tobacco use and procedure time. When comparing their results with our study, we found a much lower rate of colonization. We hypothesize that this is related to the lower incidence of infection reports in hip arthroscopic surgery versus shoulder arthroplasty (0.0%-1.2% vs 0.43%-4.6%, respectively). One possible explanation for the lower incidence of infections could be the lower colonization rate

TABLE 3
Characteristics Between Negative and Positive Cultures[a]

	Negative Culture (n = 49)	Positive Culture (n = 1)	*P*
Age, y	29.4 ± 9.0	42.0	.086
Body mass index, kg/m^2	25.0 ± 3.1	27.4	.207
Sex			>.999
Male	34 (69.4)	1 (100.0)	
Female	15 (30.6)	0 (0.0)	
Traction time, min	37.5 ± 16.2	62.0	.070
Tobacco use			>.999
Previously	3 (6.1)	0 (0.0)	
Never	46 (93.9)	1 (100.0)	
Comorbidities			
Ehlers-Danlos syndrome	1 (2.0)	0 (0.0)	>.999
Hypothyroidism	1 (2.0)	0 (0.0)	>.999
Workers' compensation	2 (4.1)	0 (0.0)	>.999
Revision surgery	7 (14.3)	1 (100.0)	.160
Diagnosis			.120
FAIS/acetabular delamination	2 (4.1)	0 (0.0)	
FAIS/labral tear	42 (85.7)	0 (0.0)	
FAIS/labral tear/os acetabuli	1 (2.0)	0 (0.0)	
Failed labral repair	3 (6.1)	1 (100.0)	
Labral tear/internal snapping	1 (2.0)	0 (0.0)	
Surgical procedure			
Femoroplasty	48 (98.0)	1 (100.0)	.999
Labral treatment			.120
Repair	42 (85.7)	0 (0.0)	
Selective debridement	3 (6.1)	0 (0.0)	
Reconstruction	3 (6.1)	1 (100.0)	
None	1 (2.0)	0 (0.0)	
Acetabular cartilage procedure with BioCartilage	3 (6.1)	0 (0.0)	>.999
Acetabular microfracture	2 (4.1)	0 (0.0)	>.999
Iliopsoas lengthening	1 (2.0)	0 (0.0)	>.999

[a]Data are reported as mean ± SD or n (%). FAIS, femoroacetabular impingement syndrome.

TABLE 4
Regression Analysis of Variables With *P* Value <.1

	Odds Ratio (95% CI)	SE	*P*
Age	1.171 (0.850-1.614)	0.163	.334
Traction time	1.061 (0.936-1.201)	0.064	.354

of *Cutibacterium acnes* in the hip. Another possible explanation could be irrigation of arthroscopic fluid as part of hip arthroscopic surgery.

A prolonged operative time during orthopaedic procedures has been shown to increase the risk for SSIs.[5] While this has not been studied in hip arthroscopic surgery, an increased operative time is a known risk factor for complications in hip arthroscopic surgery.[2] A systematic review by Go et al[12] demonstrated that a learning curve ranging fromÒ0 to >500 cases were required for surgeons to become sufficiently proficient enough to decrease the surgical time and complication rates. While the current study utilized a single senior surgeon, both revision surgery (16.0%) and labral reconstruction (8.0%) were included in this study, possibly introducing prolonged operative times to both the experimental and the control groups. Although this study did not identify increased surgery duration as a risk factor for microbial colonization, surgeons under the proficiency curve should be mindful of the potential risk.

Based on the results of the present study, the rate of the microbial colonization of traction sutures in hip arthroscopic surgery was low. One traction suture and 1 control suture in a single patient resulted in a positive culture, and the patient demonstrated no clinical signs of an infection. Surgeons, especially those still within the learning curve, should be mindful of both intrinsic and extrinsic risk factors for an SSI and use best clinical judgment when incorporating traction sutures.

Limitations

Although this study has several strengths, there are some limitations that must be acknowledged. First, the variability in surgical procedures performed was not controlled and may limit the generalizability of the findings. Second, the sample size used in the study was small and may not be able to capture all trends that are associated with positive microbial cultures using sutures. While both increased age and increased traction time were seen in the group with positive cultures, there was no significant difference when compared with the group with negative cultures.

Specialized methods such as the Crawford-Howell test were used to analyze the data, but there are still chances of a type II error. Additionally, logistic regression requires a large number of samples, and the findings of this study may not be fully representative of the general population. Future studies with larger sample sizes are needed to reaffirm the findings of this study and to identify associated factors related to the microbial colonization of traction sutures. Third, contamination is a possible confounding factor when creating these cultures.

CONCLUSION

The rate of the microbial colonization of capsular traction sutures used in hip arthroscopic surgery was low, and no patient-associated risk factors were identified for microbial colonization. Capsular traction sutures used in hip arthroscopic surgery were not a significant potential source of microbial contamination. Based on these results, capsular traction sutures can be incorporated in capsular closure with a low risk of seeding the hip joint with microbial contaminants.

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