Matthew Reuter

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Incidence of Post-Operative Shoulder Infection in Arthroscopies Done with and without the Spider Limb Positioner

Matthew Reuter MD, Charles Rizzo MD, David Gentile MD, Christopher Spagnuola MD, Gregg Foos MD, Sunil Thacker MD, Kenneth Chern MD, and David Dickerson MD

Monmouth Medical Center Department of Orthopaedic Surgery

Introduction

Though rare, post-operative infection can be a devastating complication of shoulder arthroscopy. In the setting of a rotator cuff repair, treatment of a post-operative infection requires takedown of the repair with removal of all sutures and up to 6 weeks of IV antibiotic therapy[1]. Infection incidence has been measured between 0.006% and 3.4% depending on the source[2]. Aseptic preparation is vital to the limitation of peri-operative infection and different modes of skin preparation have been studied. Saltzman et al. compared ChloraPrep (2% chlorhexidine gluconate and 70% isopropyl alcohol), DuraPrep (0.7% iodophor and 74% isopropyl alcohol), or povidone-iodine scrub and paint (0.75% iodine scrub and 1.0% iodine paint) in their ability to eliminate shoulder skin flora as determined by pre- and post-preparation cultures[3]. ChloraPrep was shown to be the most effective of these agents at eliminating skin flora.

The routine use of peri-operative antibiotics has also been shown to lower the risk of post-operative infection in shoulder arthroscopy. Randelli et al. report a six-fold decrease in the risk of infection (0.8 per 1000 patients vs. 5.9 per 1000 patients) in patients given peri-operative antibiotics compared to those not given antibiotic prophylaxis[4].

The Spider limb positioner (Smith and Nephew, London, United Kingdom) is sometimes used to maintain the operative-side arm in a stable position during arthroscopic shoulder surgery. This device involves a pneumatically powered arm that can be repositioned with a foot pedal to allow movement of the operative arm without requiring a surgical assistant. The Spider is set up by attaching a clamp to either the side rail of the operating table or the raised back of the table for procedures done in the beach-chair position. A pneumatic arm is then attached to the clamp. The arm has three joints which allow for extensive range of motion of the operative arm in abduction/adduction, flexion/extension, and internal/external rotation. The apparatus is connected to a foot pedal and the OR nitrogen source using a hose, allowing for adjustment of the Spider's position using the foot pedal[5].

The patient's arm is placed in a brace that is connected to the Spider pneumatic arm using a sterile "Piggy Back" connector. This connector is inserted into a non-sterile ball-in-socket receptor at the tip of the pneumatic arm. Following placement of this connector a sterile drape is placed over the pneumatic arm and brought down to the floor. This sterile drape is usually grasped from the inside by a non-sterile assistant and pulled down the pneumatic arm until the sterile connector is once again exposed at the other end of the drape.

The Spider can be a tremendously helpful tool in positioning a patient's limb for surgery without the need of an additional set of hands in the operating room. However, the sterile-unsterile interface created by the connector insertion and the need for a non-sterile person to position the drape raises questions about possible contamination of the connector, and by extension the operating field. Through a retrospective review of infection rates for procedures done with and without the Spider, we seek to determine whether the Spider brings an increased risk of post-operative infection. Our null hypothesis states that shoulder arthroscopies done with the Spider are not linked to an increased rate of post-operative infection.

Materials and Methods

Using CPT codes (29805, 29806, 29807, 29823, 29826, 29827, 29828) we identified all shoulder arthroscopies performed by the participating attending surgeons from 2006 up to the present time. Code searches were performed by our hospital's risk management department and by individual attending surgeons' offices. Procedures performed at our hospital and at outpatient surgery centers were included. Shoulder arthroscopies were divided into two groups, those performed with a Spider limb positioner and those performed without one. Certain attendings (C.R., D.G., and D.D.) used the Spider for all cases while the rest did not use the Spider. A second CPT code search (23030, 23031, 23035, 23040) was then run looking for patients who had a shoulder arthrotomy or irrigation and debridement to treat an infection. Any patient who had a procedure from the second CPT code group within 24 months of a procedure from the first CPT code group on the same shoulder was considered positive for a post-operative infection. Infected patients were then divided into groups based on whether their surgery was performed with or without a Spider. An infection rate was then calculated for each group by dividing the total number of infections by the total number of arthroscopies. Infection rates for the two groups were then compared for statistical significance using a Fisher's exact test. A post-hoc power analysis was then performed. GraphPad QuickCalcs (GraphPad Software, La Jolla, CA) was used for the statistical analysis. G-Power[6] (Universitat Dusseldorf, Dusseldorf, Germany) was used for the power calculations.

This study was performed in conjunction with our hospital's risk management office and approved by our hospital's institutional review board (IRB) with a waiver from formal review due to its retrospective nature.

Results

Four total infections were found in the Spider group out of a total of 2,096 shoulder arthroscopies (0.19%), compared to one infection in 3,416 procedures (0.02%) in the non-Spider group. Though this was a nearly ten-fold difference of infection rates it still fell just short of statistical significance on a Fisher's exact test ($p = 0.07$). These findings are summarized in the table below:

Table 1

	Infections	No Infection
Spider group	4	2092
Non-spider group	1	3415

A post-hoc power analysis showed that the study's power to detect statistical significance was 42.7%.

Discussion

Our results confirm that post-operative infection of the shoulder following arthroscopy is a rare event, perhaps rarer even than suggested by the literature. The rates of infection for both groups in the study were in the lower portion of the distribution quoted by Saltzman et al[2]. Both rates were also lower than the 0.27% given by Yeranosian et al in a review of over 165,000 shoulder arthroscopies from an insurance company database[7].

Though the infection rate was noticeably higher in the Spider group compared with the non-Spider group two caveats should be noted. First, three of the four infections in the Spider group occurred in a recent ten-month span with the same attending surgeon, who has used the Spider for many years without changing his surgical protocol. Excluding these infections leaves just one over the previous eight years of arthroscopies using the Spider. This cluster of infections could be merely coincidental or perhaps the result of a new common cause present only in that time. Absent a change in the method of use of the Spider, it seems unlikely that three infections would suddenly appear so close together after years without any infections as a result of the Spider. Second, the very small proportions (tenths and hundredths of one percent) measured in this study are susceptible to significant variation as the result of random occurrences. A study performed in the same manner as this one twelve months earlier would have missed the three recent infections, leaving the same number of infections in each group (one). The absence of these three infections would remove any proximity of the results to statistical significance.

The most significant limitation in this study was the lack of power. When data analysis began an infection rate of several tenths of one percent was expected for each group, consistent with the literature. Estimations of power showed that differences of infection rates near 0.5% could be determined with approximately 80% power in a study with the number of arthroscopies we collected (5,512 procedures). At the rates of infection we found, a study with 80% power to detect a statistically significant difference of infection rates would require approximately 13,500 shoulder arthroscopies. Given that a review of nine years' worth of data from our hospital and attending surgeons' offices produced less than half that number, a study that large would almost certainly require the participation of surgeons at other centers.

Might a study of tens of thousands of shoulder arthroscopies done with and without the Spider uncover a statistically significant difference in infection rates? Theoretically, yes. Whether such a difference would be large enough to be clinically important is less certain. A 0.19% infection rate with the Spider corresponds to approximately one infection for every 500 shoulder arthroscopies. None of the attending surgeons in our study averaged more than 300 such procedures a year, at which rate an infection would occur on average once every other year. An infection rate corresponding to the non-Spider group's rate would decrease this occurrence to once every twelfth year given the same annual number of arthroscopies. While such a difference would be noticeable, confounding variables such as patient health would make attributing such a difference exclusively to the presence or absence of the Spider very difficult.

Other limitations of the study include a lack of information on patient characteristics, such as age, sex, medical history, and prior surgical history. Knowing characteristics such as the proportion of diabetes patients in each group may uncover biases toward a higher infection rate in one group or the other. The use of multiple surgical locations could theoretically mask differences in the setup or use of the Spider between them, but given the large number of patients required to get adequate statistical power it would be nearly impossible to avoid the use of multiple surgical locations in a study of this kind.

We conclude that use of the Spider limb positioner poses no significant added risk of post-operative infection to the shoulder arthroscopy patient. Though it is possible that a larger study could demonstrate a statistically significant difference in infection rates with and without the Spider, the very rare occurrence of post-operative shoulder infections makes it unlikely that such a difference, if it existed, would provide meaningful guidance to surgical practice.

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