OPEN

PRS GLOBAL OPEN

ORIGINAL ARTICLE
Hand

Antibiotic Prophylaxis for Distal Interphalangeal Joint Arthrodesis

Sahil F. Vohra, DO*
Jadon H. Beck, BA*
Patrick C. Barrett, MS†
Cesar J. Bravo, MD*†
Peter J. Apel, MD, PhD*†

Background: Prior evidence is clear that in clean, elective soft-tissue hand procedures less than 2 hours, antibiotic prophylaxis is not indicated. However, there is a lack of consensus regarding the boney procedures of the hand involving implanted hardware. Previous studies reviewing complications after distal interphalangeal (DIP) joint arthrodesis did not analyze whether patients receiving antibiotics before surgery had a significant difference in the infection rate.

Methods: A retrospective review of clean, elective DIP arthrodesis was conducted between September 2018 and September 2021. The subjects were aged 18 years and older and underwent elective DIP arthrodesis for the treatment of osteoarthritis or deformity of the DIP joint. All the procedures were performed using an intramedullary headless compression screw. The rates of postoperative infections and treatments required for infections were recorded and analyzed.

Results: Overall, 37 unique patients had at least one case of DIP arthrodesis that met the criteria for inclusion in our analysis. Twenty of the 37 patients did not receive antibiotic prophylaxis, and 17 of the 37 patients received antibiotic prophylaxis. Five of the 20 patients who did not receive antibiotics prophylactically developed infections, and none of the 17 patients who received antibiotics prophylactically developed an infection. Fisher exact test revealed a significant difference in the infection rates between the two groups ($P < 0.05$). There was no significant difference in infections with respect to smoking or diabetes status.

Conclusion: Antibiotic prophylaxis should be administered for clean, elective DIP arthrodesis, using an intramedullary screw. *(Plast Reconstr Surg Glob Open 2023; 11:e4848; doi: 10.1097/GOX.0000000000004848; Published online 6 March 2023.)*

INTRODUCTION

Current recommendations for upper extremity surgeons are that for clean, elective hand surgery, antibiotic prophylaxis is not needed.[1] The existing literature supports these recommendations against antibiotic prophylaxis for clean, elective hand procedures lasting less than two hours.[2–7] A retrospective review of 8850 cases of clean, elective soft-tissue hand surgery found no significant difference in surgical site infections between patients who received antibiotic prophylaxis and those who did not.[2] Another large retrospective analysis using a multistate commercial insurance claims database to maximize sample size also found no significant difference in surgical site infection for clean soft-tissue hand surgery between patients who received antibiotics preoperatively and those who did not.[3] These recommendations and findings were largely based on a review of outcomes after common elective soft-tissue hand procedures, such as carpal tunnel release, De Quervain release, trigger finger release, and excision of masses.[2–5] There is a lack of evidence or guidelines on antibiotic prophylaxis for other common elective procedures involving implants or hardware. This information is important for surgeons to guide their decision-making. Patients prescribed antibiotics unnecessarily may have drug or allergic reactions or may develop other infections, such as pseudomembranous colitis due to *C. difficile*.[8]

A previous prospective study of 149 consecutive patients undergoing open reduction and internal fixation of a closed ankle fracture showed no significant

*From the *Department of Orthopaedic Surgery, Carilion Clinic, Roanoke, Va.; and †Virginia Tech Carilion School of Medicine, Roanoke, Va.*

Received for publication September 20, 2022; accepted January 4, 2023.

DOI: 10.1097/GOX.0000000000004848

Disclosure: *The authors have no financial interest to declare in relation to the content of this article.*

Related Digital Media are available in the full-text version of the article on www.PRSGlobalOpen.com.

difference in the rates of surgical site infections between patients who received antibiotics preoperatively and those who did not.[9] Another review of pediatric orthopedic surgery found that antibiotic prophylaxis for minimally invasive pediatric orthopedic procedures, including percutaneous pinning, did not significantly reduce surgical site infection.[10] These findings question whether antibiotic prophylaxis is indicated in clean orthopedic procedures that involve hardware.

Common surgical techniques for DIP arthrodesis use Kirschner wires or compression screws, with or without a head for fixation.[11] Screws have been shown to have accelerated rates of fusion owing to the compressive force provided by screws compared with Kirschner wires. There is also the risk of pin tract infections or wires getting caught on clothing and other objects.[12] As a result, many surgeons have transitioned to using headless compression screws to avoid the complication of painful distal hardware of a screw with a head.[13,14] Other complications after DIP arthrodesis include painful nonunion, osteomyelitis/deep infection, dorsal skin necrosis, cold intolerance, and superficial wound infections[11] Deep infection may lead to subsequent surgery and nonunion, and may cause persistent pain for patients.[11] Stern et al performed an analysis in 1992 of 181 fusions performed using both Kirschner wires and a Herbert compression screw, and found an osteomyelitis and deep wound infection rate of 4.9%.[11] In a retrospective review of 310 cases of arthrodesis (221 finger DIP and 89 thumb IP arthrodesis), 50 cases (16%) were infected, with the majority of these being superficial infections.[15] However, in a review by Villani et al, there were no cases of infection in a DIP arthrodesis series of 102 joints.[16] None of the aforementioned studies specified the use of preoperative antibiotics.

With the popularization of wide-awake local anesthetic with no tourniquet (WALANT) hand surgery, IV placement is no longer required. Therefore, routine prophylactic antibiotics are generally not used in patients with WALANT. At our institution, we increased the use of WALANT from 2018 to 2021, and prophylactic antibiotics were not used in WALANT cases. This change in practice afforded the opportunity to examine DIP infections, and a retrospective review of procedures over the past three years was initiated.

METHODS

This was a retrospective chart review of all DIP arthrodesis procedures performed at our institution between November 2018 and November 2021. Inclusion criteria included patients aged 18 years or older who had undergone elective, clean, DIP arthrodesis with intramedullary screw fixation, and documentation of whether antibiotic prophylaxis was administered. Patients who underwent DIP arthrodesis due to acute injury, revision procedures, or DIP procedures with any concurrent procedures other than mucous cyst excision were excluded. The inclusion and exclusion criteria are listed. (**See table, Supplemental Digital Content 1,** which displays the full inclusion and exclusion criteria. DIP indicates distal interphalangeal. **http://links.lww.com/PRSGO/C439**.)

Takeaways

Question: Is antibiotic prophylaxis required for distal interphalangeal joint arthrodesis procedures?

Findings: A significant difference in infection rates was noted between patients who received antibiotics prophylactically and those who did not.

Meaning: Patients undergoing distal interphalangeal joint arthrodesis procedures should be given antibiotics prophylactically.

The following data were collected for each patient: age, sex, race, smoking status, diabetes mellitus status, preoperative antibiotic administration, anesthesia used, duration of the procedure, postoperative infections, and any treatment to address postoperative infection if it occurred. All the procedures were performed in an operating room with full sterility. Procedure was performed with a dorsal incision, and the bone was prepared using either a rongeur or high-speed bur. A pin was placed antegrade from arthrodesis site out the tip of the finger and then retrograde down the shaft of the middle phalanx to the base. A stab incision was made in the fingertip, and the cannulated drill was then placed from the fingertip across the distal phalanx into the diaphysis of the middle phalanx; the screw was then placed over the wire. All screws used in these procedures were either Accutrak 2 headless compression screw by Acumed or the REDUCT headless compression screw by Skeletal Dynamics. No procedures were performed in an in-office procedure room, and no procedures were performed with field sterility. Patients who received antibiotics prophylactically were administered either intravenous cefazolin or clindamycin. The sequence of events for the patients in our study was injection of lidocaine as a local anesthetic, administration of antibiotics if ordered by the surgeon, preparation and draping, application of a finger tourniquet if epinephrine was not used, and incision.

Statistical Methods

Data were analyzed by the total number of unique patients and not by the total number of DIP procedures, as some patients in our data set had multiple DIP procedures performed during the same surgical encounter. All analyses were performed using Fisher exact test.

RESULTS

During the period of November 2018 to November 2021, a total of 136 DIP procedures were performed at our institution. Forty-four of these procedures met the inclusion criteria, with 37 being unique, as seven of the patients had two DIP procedures performed on the same day.

Of the 37 patients undergoing DIP procedures who met the inclusion criteria, 20 were not administered antibiotics prophylactically, and 17 were administered antibiotics prophylactically. There were no significant differences

between the groups that received prophylactic antibiotics and those that received did not receive antibiotics regarding their diabetes or smoking status. There was also no significant difference between the groups regarding the brand of screw used. Five of the patients in the group who did not receive antibiotics prophylactically later went on to develop an infection postoperatively, with four of these infections requiring subsequent screw removal, and one patient developed a superficial infection that only required a course of oral antibiotics for treatment. No infections were observed in the group of patients who received prophylactic antibiotics. Using a Fisher exact test, it was shown to be a significant difference between the groups regarding infection ($P < 0.05$). [**See table, Supplemental Digital Content 2**, which displays the variables by group. Groups consist of patients who received antibiotic prophylaxis and patients who did not receive antibiotic prophylaxis for their DIP arthrodesis procedures. Significant findings of $P < 0.05$ are demonstrated with an asterisk. Statistical significance for infection, brand of screw used, number of smokers, and diabetic patients was calculated using a Fisher exact test. Statistical significance for mean age (in years) was calculated using two-sample *t* test. **http://links.lww.com/PRSGO/C440**.]

Of note, all but one patient who was administered antibiotics prophylactically received some form of general anesthesia or sedation, and this was statistically significant ($P < 0.0001$).

There were no significant effects of diabetes status or smoking status on infection rates ($P = 0.2663$ and 1.000, respectively). (**See table, Supplemental Digital Content 3,** which displays the incidence of infection by diabetes and smoking status in no antibiotic prophylaxis group. Statistical significance was calculated using a Fisher exact test. **http://links.lww.com/PRSGO/C441**.)

DISCUSSION

As the practice of hand surgery evolves, more procedures are being performed under local anesthesia, including those utilizing hardware and other implants. The current guidelines for soft-tissue hand procedures recommend against antibiotic prophylaxis.[2–6,17] However, there is little data for guidelines on clean elective procedures with implanted hardware, such as DIP arthrodesis. This can have major implications for patients when infection develops after these procedures involving hardware, as it may require additional surgery to remove the hardware or for revision procedures. Routine use of IV antibiotics unnecessarily risks adverse reactions, results in poor antibiotic stewardship, and has implications for procedural workflow.

Our review suggests that antibiotic prophylaxis is necessary before DIP arthrodesis using intramedullary screw fixation, even in clean elective procedures. We postulate that the increased risk of infection is due to the unique nature of the hardware placement through the hyponychium. This can be a difficult area to surgically prepare and may harbor bacteria after standard surgical preparation. A probable source of infection is the thread of the screw pulling regional contaminants when inserted through a small incision in the fingertip. It is unknown if infection rates would be lower if patient nails are trimmed, special cleaning under the nail is performed or if a larger hyponychial incision is made so that skin edges can be retracted, thus minimizing the threads of the screw dragging possible contaminants internally. Given the retrospective nature of the study, the size of the incision was not measured or documented. Because of the unique nature of this posited mechanism, we should cautiously interpret our results for all hand procedures with implanted hardware.

We would recommend optimization of the antibiotic prophylaxis administration for DIP procedures. It is recommended that patients are injected with local anesthetic 25 minutes before incision for minimization of intraoperative bleeding using epinephrine in combination with a local anesthetic such a lidocaine.[18] Due to the vasoconstriction caused by epinephrine administration, antibiotic prophylaxis should be administrated before local anesthetic injection to ensure antibiotic delivery to the surgical area is not impacted. Antibiotics should also be administrated before digital tourniquet application if epinephrine is not used. However, antibiotics should not be administrated more than 120 minutes before time of incision.[19]

Our study has several limitations. First, a small number of patients were analyzed over a 3-year period. The number of procedures performed during this period was affected by the corona virus 2019 pandemic, in which many elective orthopedic procedures were canceled or postponed. Second, excluding elective DIP procedures that involve other concurrent procedures may limit the generalizability of the results. In our case series, nearly all patients who did not receive antibiotics prophylactically underwent procedures performed under WALANT. Although anesthesia itself is unlikely to have contributed to the outcomes, this is an important variable in this case series. Despite these limitations, the results are significant and have practical implications. Antibiotic prophylaxis was not optimized regarding the timing of administration in our cases given the retrospective nature of our study. Despite this, a statistically and clinically meaningful difference was still found between groups.

Future research should compare methods of skin and nail preparation and compare prophylactic oral antibiotics with IV antibiotics, especially given that the bioavailability of some antibiotics is equivalent for oral and IV antibiotics.[20] Examples would be cephalexin (Keflex), which has more than 90% bioavailability when taken orally, and would be an alternative to IV antibiotics for WALANT procedures.[21] Additional research should examine other bony hand cases with implants such as metacarpophalangeal fusion, first carpometacarpal arthroplasty, or proximal interphalangeal arthroplasty. The nature of the skin incision in these cases and the mechanism of hardware implantation are fundamentally different from those of the placement of a headless compression screw for DIP arthrodesis. Because of this fundamental difference, we encourage a narrow interpretation of our results

to be applicable to DIP arthrodesis only and not generalizable to all boney hand surgery cases.

CONCLUSION

Antibiotic prophylaxis using an intramedullary screw is necessary for clean and elective DIP arthrodesis to reduce the risk of postoperative infection.

Peter J. Apel, MD, PhD
2331 Franklin Rd SW
Roanoke, VA 24014
E-mail: dr.peter.apel@gmail.com

ACKNOWLEDGMENTS

The study was carried out under the research program of the Carilion Clinic Department of Orthopaedic Surgery. Gratitude is extended to Tonja M. Locklear, PhD for her assistance with statistical analysis.

REFERENCES

1. Ariyan S, Martin J, Lal A, et al. Antibiotic prophylaxis for preventing surgical-site infection in plastic surgery: an evidence-based consensus conference statement from the American Association of Plastic Surgeons. *Plast Reconstr Surg.* 2015;135:1723–1739.
2. Bykowski MR, Sivak WN, Cray J, et al. Assessing the impact of antibiotic prophylaxis in outpatient elective hand surgery: a single-center, retrospective review of 8,850 cases. *YJHSU.* 2011;36:1741–1747.
3. Li K, Sambare TD, Jiang SY, et al. Effectiveness of preoperative antibiotics in preventing surgical site infection after common soft tissue procedures of the hand. *Clin Orthop Relat Res.* 2018;476:664–673.
4. Tosti R, Fowler J, Dwyer J, et al. Is antibiotic prophylaxis necessary in elective soft tissue hand surgery? *Orthopedics.* 2012;35:e829–e833.
5. Harness NG, Inacio MC, Pfeil FF, et al. Rate of infection after carpal tunnel release surgery and effect of antibiotic prophylaxis. *J Hand Surg.* 2010;35:189–196.
6. Aydin N, Uraloğlu M, Burhanoğlu ADY, et al. A prospective trial on the use of antibiotics in hand surgery. *Plast Reconstr Surg.* 2010;126:1617–1623.
7. Dow Hoffman R, Adams BD. The role of antibiotics in the management of elective and post- traumatic hand surgery. *Hand Clin.* 1998;14:657–666.
8. Dunn JC, Means KR, Jr, Desale S, et al. Antibiotic use in hand surgery: surgeon decision making and adherence to available evidence. *Hand (N Y).* 2020;15:534.
9. Paiement GD, Renaud E, Dagenais G, et al. Double-blind randomized prospective study of the efficacy of antibiotic prophylaxis for open reduction and internal fixation of closed ankle fractures. *J Orthop Trauma.* 1994;8:64–65.
10. Formaini N, Jacob P, Willis L, et al. Evaluating the use of preoperative antibiotics in pediatric orthopaedic surgery. *J Pediatr Orthop.* 2012;32:737–740.
11. Stern PJ, Fulton DB. Distal interphalangeal joint arthrodesis: an analysis of complications. *J Hand Surg Am.* 1992;17:1139–1145.
12. Tomaino MM. Distal interphalangeal joint arthrodesis with screw fixation: why and how. *Hand Clin.* 2006;22:207–210.
13. Matsumoto T, Nakamura I, Miura A, et al. Distal interphalangeal joint arthrodesis with the reverse fix nail. *J Hand Surg Am.* 2013;38:1301–1306.
14. Engel J, Tsur H, Farin I. A comparison between K-wire and compression screw fixation after arthodesis of the distal interphalangeal joint. *Plast Reconstr Surg.* 1977;60:611–614.
15. Heinonen A. Factors influencing bone union in finger distal interphalangeal and thumb interphalangeal joint arthrodesis. *J Hand Surg Asian Pac.* 2020;25:184–191.
16. Villani F, Uribe-Echevarria B, Vaienti L. Distal interphalangeal joint arthrodesis for degenerative osteoarthritis with compression screw: results in 102 digits. *J Hand Surg.* 2012;37:1330–1334.
17. Hoffman RD, Adams BD. The role of antiobiotics in the management of elective and post-traumatic hand surgery. *Hand Clin.* 1998;14:657–666.
18. McKee DE, Lalonde DH, Thoma A, et al. Optimal time delay between epinephrine injection and incision to minimize bleeding. *Plast Reconstr Surg.* 2013;131:811–814.
19. De Jonge SW, Gans SL, Atema JJ, et al. Timing of preoperative antibiotic prophylaxis in 54,552 patients and the risk of surgical site infection: A systematic review and meta-analysis. *Medicine (Baltim).* 2017;96:e6903.
20. Li H-K, Rombach I, Zambellas R, et al. Oral versus intravenous antibiotics for bone and joint infection. *N Engl J Med.* 2019;380:425–436.
21. Verhaegen J, Verbist L. Oral cephalosporins. *Acta Clin Belg.* 1992;47:377–386.