Original Article

No Wound Healing Complications or Recurrences Were Seen and a High Level of Satisfaction Was Reported in Patients Who Underwent Endoscopic Olecranon Bursectomy for Recalcitrant Olecranon Bursitis

Jeffrey R. Simpson, M.S., Austin Fagerberg, M.S., Robert Toledo, M.D., and Patrick W. Joyner, M.D.

Purpose: To determine the outcomes of endoscopic olecranon bursectomy for the treatment of recalcitrant olecranon bursitis in one surgeon's practice. **Methods:** A retrospective analysis was conducted on all patients who underwent an endoscopic olecranon bursectomy for the treatment of recalcitrant olecranon bursitis between January 2018 and May 2021 at one surgeon's practice. Demographic variables as well as causes for olecranon bursitis such as aseptic, septic, and gouty tophi were recorded. In addition, any complications such as infection, recurrence, wound failure, or hospitalizations were documented, with wound dehiscence, recurrence of bursitis, and return to the operating room being the primary outcome measures. During the final phone encounter before finalizing this project, patients were queried to obtain the patient-reported form of the American Shoulder and Elbow Surgeons Elbow Questionnaire, quick Disabilities of the Arm Shoulder and Hand score, and the Single Assessment Numeric Evaluation score. **Results:** Our study included 28 patients (23 male and 5 female) with an average age of 68 years (ranging from 33-86 years), all of whom had follow-up. The average follow-up was 24.7 months (range 3-42 months). There were 15 cases (54%) of aseptic bursitis, 13 cases (46%) of septic bursitis, and 7 cases (25%) that contained gouty tophi (5 aseptic and 2 septic). Of the 28 patients, 4 experienced complications. These all occurred within 3 months of surgery. One necessitated hospitalization and intravenous antibiotics, 2 were minor infections treated with oral antibiotics, and one was swelling treated successfully with in-office aspiration. Overall, 24 (86%) patients reported no issues at all related to the surgery. There were no instances of recurrence, wound failure, or secondary operations. Of the 20 (71.4%) patients who were reached for patient-reported form of the American Shoulder and Elbow Surgeons Elbow Questionnaire, quick Disabilities of the Arm Shoulder and Hand score, and Single Assessment Numeric Evaluation scores, all 20 patients reported no residual pain or difficulties with daily tasks. Average satisfaction with the procedure was 9.9 of 10 and, on average, patients reported that their elbow functionality was 96% with 100% representing completely normal. **Conclusions:** In this population, patients who underwent endoscopic olecranon bursectomy experienced no recurrences or wound-healing complications necessitating return to the operating room. In addition, patients reported high function and satisfaction after the procedure. **Level of Evidence:** Level IV, therapeutic case series.

Olecranon bursitis is a swelling of the bursal cavity over the olecranon when there is an abnormal increase in the volume of fluid.[1] The olecranon bursa is the most commonly inflamed bursa in the human body.[2] The superficial position and limited vascularity of the bursa makes it particularly vulnerable to this condition. This injury and its resulting inflammation are commonly seen in patients who expose their elbows to

From the University of Central Florida College of Medicine, Orlando, Florida, U.S.A. (J.R.S., R.T.); John P. and Kathrine G. McGovern Medical School at UTHealth, Houston, Texas, U.S.A. (A.F.); and OrthoCollier, Naples, Florida, U.S.A. (P.W.J.).

Presented at the AANA 2023 national meeting, New Orleans, Louisiana, May 4, 2023, to May 6, 2023.

Received July 22, 2023; accepted November 5, 2023.

Address correspondence to Jeffrey R. Simpson, University of Central Florida, 6850 Lake Nona Blvd., Orlando, Florida 32827, U.S.A. E-mail: je151677@ucf.edu

2666-061X/23986

https://doi.org/10.1016/j.asmr.2023.100832

repeated trauma through professions, hobbies, or other activities.[3] Mechanical bursitis is the most common, but approximately one third of olecranon bursitis cases are septic.[4] Although it is less commonly noted in the literature, tophaceous gout is also a comorbidity and causative agent of olecranon bursitis.[5,6]

Conservative treatment methods for these various forms of olecranon bursitis have been outlined in the literature.[1,7] These methods include aspirations, nonsteroidal anti-inflammatory drugs, compression, immobilization, and antibiotics in septic cases. It is widely recognized that olecranon bursitis that persists despite conservative treatment requires surgical intervention; however, a unanimous consensus has not been reached on the optimal surgical method. The standard treatment of an open bursectomy is regarded as a simple and an endoscopic approach may be seen as unnecessarily complex and without substantial evidence to support its use. Therefore, an open olecranon bursectomy remains the method of choice for many physicians. However, in a retrospective case series of open olecranon bursectomies, wound-healing problems were noted in 27% of patients, and recurrence was seen in 22%.[8] Another study found that the revision rate following open olecranon bursectomies was 11.5%.[9]

An open olecranon bursectomy involves excision via an incision directly above the bursa. Such an excision in an area with limited blood supply and common cellulitis makes the wound less likely to heal and more likely than other areas to experience complications requiring returns to the operating room.[10] The nature of this surgical wound and its healing time also can prove very bothersome and inconvenient for patients, especially when attempting to return to a job that requires significant motion or potential mechanical trauma to the elbow.

These difficulties inherent in the open bursectomy, primarily the problems with wound healing and recurrence,[8] have led to an exploration of endoscopic excision as a treatment option after the technique was described be Kerr and Carpenter in 1990.[11] Although endoscopic bursectomies have been referred to as "quite uncommon" and their advantages have been deemed "theoretical" as recently as 2014,[1] there have been some recent small studies displaying promising results for endoscopic bursectomies performed on patients with olecranon bursitis, including those with infections present.[12-14] However, more evidence for this approach to treatment is required, and concerns do linger about the ability of an endoscopic procedure to remove enough septic bursa to prevent recurrence.[10,11] The purpose of this study was to determine the outcomes of endoscopic olecranon bursectomy for the treatment of recalcitrant olecranon bursitis in one surgeon's practice. We hypothesized that an endoscopic technique for the treatment of olecranon bursitis would lead to a low wound-healing complication rate and low recurrence rate with few returns to the operating room in this patient population.

Methods

Patient Selection

A retrospective chart review was conducted by the researchers. In this review, patients who had undergone endoscopic olecranon bursectomies were identified. The inclusion criterion was any patients with olecranon bursitis who then underwent an endoscopic bursectomy.

All included patients experienced recalcitrant olecranon bursitis that was unresponsive to conservative treatments including aspirations, compression, and medications such as nonsteroidal anti-inflammatory drugs and antibiotics in septic cases. Preoperative assessment was carried out by the operative surgeon (P.W.J.) and patients were deemed acceptable candidates for endoscopic surgery. Following the procedures, the operative surgeon (P.W.J.) performed postoperative examinations on all patients.

Clinical Assessment

The indication for an endoscopic olecranon bursectomy is that the patient must be experiencing recalcitrant olecranon bursitis that has not responded to multiple attempts at conservative treatment. This includes aspirations, antibiotics, compression, and anti-inflammatory agents. In septic cases, surgical intervention is more urgent and is recommended if the patient does not show improvement with antibiotic therapy in 2 to 3 days. This procedure can be performed in the presence of actively draining sinuses from the bursa. However, caution should be used if the bursa is too enlarged or there are large amounts of gouty tophi. This determination is left to clinical decision-making and the comfort of the surgeon with the procedure. In these cases, there is a serious risk of failure secondary to incomplete excision of the tophi, and an open procedure is the best option for the patient. Patients with previous open bursectomies and recurrence can be considered for an endoscopic procedure.

When a patient presents with a bothersome case of olecranon bursitis and notable fluid accumulation, the first step is aspiration. If the aspirate is clearly purulent, then the patient should be prescribed oral antibiotics and be scheduled for bursectomy within 2 to 4 days. On the day of surgery, they can be assessed for improvement and may not require bursectomy if they are improving. Patients with systemic symptoms of infection should be considered for admission and intravenous antibiotics followed by serial examinations to assess the need for surgery. In patients without clear signs of infection, aspirate should still be cultured for bacteria. Oral

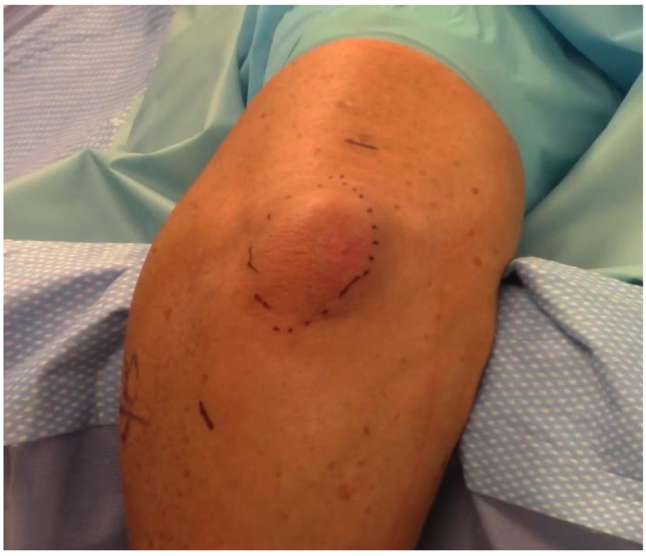

Fig 1. Operative extremity with incision sites marked.

anti-inflammatory drugs also can be prescribed. Following aspiration, an elastic bandage will be wrapped tightly around the affected elbow, and patients are instructed to wear it for 2 days with a 5-pound weight-lifting limit. The patient will be seen again in 2 weeks to assess the response to treatment. If there is recurrence, the same steps will be taken again. In the vast majority of cases, patients experience resolution after these conservative measures. If patients continue to experience bothersome olecranon enlargement and pain, or an infection is confirmed, then they should be engaged in a conversation about operative management. All patients included in this study either required surgery due to persistent infection or do not respond to conservative management and elected to have surgery.

Surgical Method

The patient is placed in the lateral position with an axillary roll in place and all prominences are well-padded using a beanbag and an elbow post. A tourniquet is placed on the upper extremity of the operative arm. After prepping and draping in the normal standard manner, incisions are marked. One superior incision is marked 2 fingerbreadths proximal and horizontal to the olecranon bursa. One inferior incision is marked 2 fingerbreadths distal and deviated slightly radial to the bursa in line with Langer lines (Fig 1). Each incision is 1 cm. The operative extremity is exsanguinated, but great care is taken to not exsanguinate the bursa so that that fluid can be used to aid in bursal entry. The tourniquet is then inflated, and the incisions are made to be used as portals. Blunt dissection and tunneling deep to the adipose tissue are performed to create endoscopic portals to the bursa. The surgeon then enters the superior portal with the endoscope and the inferior portal with a small shaver (Fig 2). The bursa is thoroughly debrided along with any loose bodies or unhealthy tissue, and extra precautions are taken to not remove the surrounding soft tissues. Since it can be difficult to remove the complete bursa, the focus should be on removing the bursa as safely as possible as opposed to in its entirety. The blades of the shaver are ensured to always be pointed away from the skin. It is important to have an assistant visually evaluating the skin to alert the surgeon about any risk to its integrity. After debridement of the inferior portal is complete, the surgeon creates a proximal pathway for drainage into the subcutaneous tissues to aid in the healing process by debriding the underlying soft tissue from the bursa at the entrance of the portal site. The portals are then switched. Debridement is resumed from the superior portal using the same precautions used in the inferior portal; any loose bodies may be removed en bloc with endoscopic graspers. Upon completion, final pictures are taken. Instruments are removed and portal sites are closed with nylon. A soft compression dressing is placed over the elbow. The tourniquet is let down. Uncomplicated procedures are normally completed between 10 and 20 minutes. The patient is transferred to the anesthesia unit in stable condition and sent home the same day.

Postoperatively, the patient is immediately range of motion as tolerated with a 5-pound weight-lifting limit. They are instructed to wear a compression dressing for 5 days postoperatively. They will start physical therapy on postoperative day 1, and they will report to the orthopaedic clinic 2 weeks after surgery unless there are wound issues or sepsis. The patient may report at an earlier time per the operative surgeon. Once the sutures are removed and the portal sites have healed, the patient is weight-bearing and activities as tolerated. It will typically take approximately 6 weeks for all swelling to

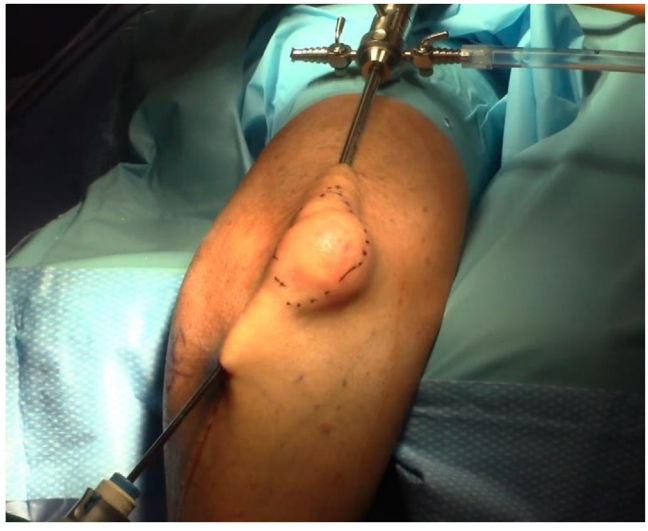

Fig 2. Operative extremity with instruments inserted.

subside and for the swelling about the bursa to completely resolve. There is also commonly some significant ecchymosis in the first 4 weeks that does take time to resolve.

Outcome Questions

Patient records were analyzed, and all follow-up appointments (2 weeks, 2 months, 6, months, 1 year, and then yearly) and findings were noted. Patients were then contacted by phone for continued follow-up every 3 months as the research was ongoing. These phone calls were at different points for each patient, as their procedures were at different times. All patients were asked about the general state of their operative extremity, and responses were recorded. They were then specifically asked if they had experienced any wound failure, infections, or recurrence, and if any of these things necessitated a hospital visit or return to the operating room. All patient info including operation date, form of bursitis, comorbidities, age, sex, operative findings, length of illness, and post-operative results were recorded.

Outcome Scores

During the final follow-up phone call by the authors, patients were queried to obtain values for the patient-reported form of the American Shoulder and Elbow Surgeons Elbow Questionnaire (pASES-e), quick Disabilities of the Arm, Shoulder and Hand score (qDASH), and the Single Assessment Numeric Evaluation (SANE) score. The ASES-e is a standardized elbow function evaluation system that was developed by the Research Committee of the ASES.[15] This system has 2 forms: a physician form based on physical examination, and a patient-reported form (pASES-e). Because we were communicating with patients via telephone, we used only the patient-reported form. Descriptive statistics were used to analyze the data. This form contains 3 sections: pain, function, and satisfaction. The pain section begins with asking if there is pain in the elbow. If the answer is no that is the end of the section. If the answer is yes, then there are 5 questions regarding pain with answers on a 0 (no pain) to 10 (worst pain ever) scale. The function section contains 12 questions regarding standard daily tasks with 4 answer options. The options are 0, which is "unable to do," 1, which is "very difficult to do," 2, which is "somewhat difficult to do," and 3, which is "not difficult." The patient satisfaction section is simply one question asking patients to rate their satisfaction with the surgery from 1 to 10 with 1 being "not satisfied at all" and 10 being "very satisfied." There is no final score for the pASES-e.

The qDASH is a shortened version of the 30-question Disabilities of the Arm, Shoulder and Hand score.[16] It contains 11 questions about simple daily tasks. Respondents will score each task from 1 to 5, with 1 meaning "no difficulty," 2 meaning "mild difficulty," 3 meaning "moderate difficulty," 4 meaning "severe difficulty," and 5 being "unable."

The SANE score is a single question assessment tool that asks patients to rate their affected joint or region as a percentage of normal.[17] Patients simply score their affected joint or region from 0 to 100%, with 100% representing completely normal function.

Results

Twenty-eight patients were identified as eligible to be included. This included 23 male and 5 female patients. Ages ranged from 33 to 86 years, with an average age of 68 years. Of the 28 included patients, 3 were lost to follow-up following their 2-month checkup. Six patients passed away after undergoing some follow-up. The operations were conducted from January 2018 through May 2021. Length of illness ranged from 3 months to 18 years.

The average follow-up time was 24.7 months (range 3-42 months); 23 patients were male and 5 were female. The average age was 68 (range 33-86). There were 2 included patients who had undergone a previous open bursectomy, experienced recurrence, and were successfully treated with an endoscopic procedure and had not experienced any further recurrence. Both of these patients had follow-up recorded over 4 years after their endoscopic procedure.

Of the 28 patients who underwent surgery, 13 were noted to have septic bursitis based on aspirate and/or culture, and 15 were classified as aseptic. Seven of the 28 were found to have gout as a causative agent or comorbidity and gouty tophi was found during their procedures (Table 2).

Postsurgical problems were noted in 4 of the 28 (14%) included patients. These issues all appeared within 3 months of surgery and included 1 instance of swelling that required in-office aspiration, 2 cases of infections, which were successfully treated with oral antibiotics, and 1 case of infection, which required hospitalization and IV antibiotics. There were no patients who experienced issues more than 3 months after surgery. No patients experienced our primary outcome variables including recurrence of their bursitis, wound dehiscence, or returns to the operating room (Table 1).

In the final follow-up phone calls, patients were queried for the pASES-e, qDASH, and SANE scores. Nonrespondents included 6 patients who died and 2 patients who were unreachable. This resulted in 20 of 22 (91%) living patients, and 71% of the original 28 patients, being reached.

For the pASES-e form, all 20 patients responded "no" when asked if they experienced residual pain related to their bursitis. Regarding function, every respondent rated each of the 12 tasks a 3 meaning "not difficult." Nineteen of the 20 respondents responded with a 10 (very satisfied) in the satisfaction section. The patient

Table 1. Patient Outcomes

Number of Patients	Average Age	Average Follow-Up Time	Patients With No Issues Related to Surgery	Patients With Mild Issues Related to Surgery Who Did Not Require Hospitalization	Patients With Issues Related to Surgery Who Required Hospitalization	Patients Who Experienced Recurrence, Return to the Operating Room, or Wound Failure
28	68 y (range, 33-86 y)	24.7 mo (range. 3-42 mo)	24 (86%)	3 (10%)	1 (4%)	0

NOTE. Mild issues related to surgery include swelling, which could be successfully treated with drainage or minor infections which were successfully treated with oral antibiotics and did not reoccur. The patient in the hospitalized group experienced an infection that required hospitalization, drainage, and intravenous antibiotics. No patients experienced recurrence of their bursitis or any issues that necessitated a return to the operating room.

who was hospitalized postoperatively for an infection scored his satisfaction as an 8 of 10 due to this complication.

In the qDASH assessment, all 20 respondents scored each of the 11 tasks as a 1 out of 5. This represents "no difficulty" for each patient in every task.

In the single-question SANE score, the average score for the 20 patients was 96%. In total, 17 patients scored their elbow region as 100%, meaning that it was completely normal. The lowest reported score was 80% of normal.

Discussion

The most important finding of this study was that with an endoscopic procedure, none of our patients experienced recurrence of their bursitis, wound dehiscence, or returns to the operating room. Only 4 (14%) of patients experienced any issues following surgery, and none of those issues fell into the categories of our outcome measures, nor where they persistent.

Upon final assessment of our patient group using the pASES-e, qDASH, and SANE score, very good outcomes were observed. No patients reported any residual pain, every patient reported full function and no difficulties with daily tasks, and 19 of 20 patients reported full 10 of 10 satisfactions with their surgery. The patient who experienced hospitalization following surgery still reported 8 of 10 satisfaction. The average for overall percentage of normal according to the qDASH was 96%. In their scoring, every patient considered their current state to be subjectively superior to their state before surgery.

Studies examining outcomes following open olecranon bursectomies as treatment for olecranon bursitis have found relatively frequent complications and wound dehiscence.[8,9,12-14] A retrospective case series by Degreef and De Smet[8] found that, following open olecranon bursectomies, 27% of patients had healing problems, and 22% experienced recurrence. In a larger and more recent retrospective study examining revision rates, Germawi et al.[9] found that 11.5% of patients who underwent open olecranon bursectomies required revisions. The outcomes measured in these studies were not seen in any of the patients in our study. None of our patients experienced recurrence, wound failure, or returns to the operating room. Any postoperative problems seen in our patients were treated with conservative measures.

In the one case of moderate complications that required intravenous antibiotics, the operative surgeon (X.X.X.) acknowledges that the bursa was too enlarged and contained too much gouty tophi for an endoscopic procedure. In the case the care required to maintain the integrity of the skin prevented adequate bursal debridement. It was a case when an open bursectomy was indicated. We believe if the previously outlined clinical assessment is followed, cases like this can easily be avoided.

The ability of an endoscopic procedure to effectively eradicate enough of a septic bursa to prevent recurrence has been called into question in the literature due to the perceived difficulty without direct visualization and an extensile incision.[10,11] Our patient group included 13 patients with septic cases of olecranon bursitis, all of whom were treated successfully without any major complications, recurrence, or hospitalizations.

Gouty tophi present in patients with olecranon bursitis can be concerning to surgeons. Seven of our included patients had gout and gouty tophi in their bursa. Of this group, only the previously mentioned

Table 2. Subdivision of Patients by Case Type

	Aseptic Cases	Septic Cases	Cases With Gouty Tophi
Number of patients	15	13	7 (2 septic, 5 aseptic)
Number of patients who experienced postoperative problems	2	2	1 (aseptic)

NOTE. The only patient who required hospitalization following surgery to treat an infection was the aseptic patient with gout. The other 3 patients experienced minor infectious symptoms handled with medication or a single in-office aspiration.

patient, who was a poor candidate for the endoscopic procedure, experienced complications. This shows that an endoscopic approach can be an effective treatment for patients with gouty olecranon bursitis.

An additional significant aspect of our patient group is that it is a primarily geriatric population with an older average age (68 years) than can be seen in other studies. This demonstrates that the procedure can be safe in elderly patients who are at greater risk of poor wound healing.

We believe that this study provides evidence of the effectiveness of this procedure in multiple different forms of olecranon bursitis. This includes septic cases, aseptic cases, cases with gouty tophi, and cases in elderly patients. This serves to assuage the concerns about more difficult cases like those that are septic or involve gout.

Another strength of our study is the relatively long follow-up time. Any postoperative issues were noted in patients within 3 months of surgery. We were able to attain a follow-up time of at least that length for every included patient and had much longer follow-up for most, with an average follow up of over 2 years. This enhances our confidence in the results and increases the validity of the findings. We believe that our results serve to bolster the growing collection of literature in support of an endoscopic approach to olecranon bursitis.[12-14]

Limitations

We acknowledge that this case series contains multiple limitations. The primary limitation is that there were not enough examples of open olecranon bursectomies to directly compare with endoscopic cases. This would have provided a more controlled comparison between the 2 approaches, rather than comparing with the literature.

This case series also has a limited number of patients. Obviously, a larger number of patients would lead to more meaningful statistics. Further directions could include a meta-analysis of the existing literature, or a randomized controlled trial at a larger institution where both endoscopic and open bursectomies are performed.

Although we believe that our reported pASES-e, qDASH, and SANE assessments strengthen the findings of our research, we acknowledge that these measures would be more meaningful had they also been assessed before surgery. They, along with our other findings, would also be more meaningful if they also contained an objective clinical assessment by a physician rather than only self-reported patient outcomes. Recall bias is also a concern with patients' subjective responses. Selection bias is also a concern, with only 20 of the 28 original patients being reached for final follow up. In addition, all preoperative assessments, surgeries, and post-operative assessments were done by one person, the operating surgeon.

Lastly, patients who opted for conservative management and declined surgery were not followed as a control group, this could be a valuable comparison and should be considered in future studies.

Conclusions

In this population, patients who underwent endoscopic olecranon bursectomy experienced no recurrences or wound healing complications necessitating return to the operating room. In addition, patients reported high function and satisfaction after the procedure.

Disclosure

All authors (J.R.S., A.F., R.T., P.W.J.) declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. Full ICMJE author disclosure forms are available for this article online, as supplementary material.

References

1. Blackwell JR, Hay BA, Bolt AM, Hay SM. Olecranon bursitis: A systematic overview. *Shoulder Elbow* 2014;6:182-190.
2. Perez C, Huttner A, Assal M, et al. Infectious olecranon and patellar bursitis: Short-course adjuvant antibiotic therapy is not a risk factor for recurrence in adult hospitalized patients. *J Antimicrob Chemother* 2010;65:1008-1014.
3. Quayle JB, Robinson MP. A useful procedure in the treatment of chronic olecranon bursitis. *Injury* 1978;9:299-302.
4. Stell IM. Septic and non-septic olecranon bursitis in the accident and emergency department—an approach to management. *J Accid Emerg Med* 1996;13:351-353.
5. Özdemir G, Deveci A, Andıç K, Erdem Yaşar N. Bilateral olecranon tophaceous gout bursitis. *Case Rep Med* 2017;2017:3514796.
6. Monu JU, Pope TL Jr. Gout: A clinical and radiologic review. *Radiol Clin North Am* 2004;42:169-184.
7. Aaron DL, Patel A, Kayiaros S, Calfee R. Four common types of bursitis: Diagnosis and management. *J Am Acad Orthop Surg* 2011;19:359-367.
8. Degreef I, De Smet L. Complications following resection of the olecranon bursa. *Acta Orthop Belg* 2006;72:400-403.
9. Germawi L, Westenberg RF, Wang F, Schep NWL, Chen NC, Eberlin KR. Factors associated with revision surgery for olecranon bursitis after bursectomy. *J Shoulder Elbow Surg* 2021;30:1135-1141.
10. Hanrahan JA. Recent developments in septic bursitis. *Curr Infect Dis Rep* 2013;15:421-425.
11. Kerr DR, Carpenter CW. Arthroscopic resection of olecranon and prepatellar bursae. *Arthroscopy* 1990;6:86-88.
12. Ogilvie-Harris DJ, Gilbart M. Endoscopic bursal resection: the olecranon bursa and prepatellar bursa. *Arthroscopy* 2000;16:249-253.
13. Meade TC, Briones MS, Fosnaugh AW, Daily JM. Surgical outcomes in endoscopic versus open bursectomy of the septic prepatellar or olecranon bursa. *Orthopedics* 2019;42:e381-e384.

14. Rhyou IH, Park KJ, Kim KC, Lee JH, Kim SY. Endoscopic olecranon bursal resection for olecranon bursitis: A comparative study for septic and aseptic olecranon bursitis. *J Hand Surg Asian Pac Vol* 2016;21:167-172.
15. Vincent JI, MacDermid JC, King GJW, Grewal R. The Patient-Rated Elbow Evaluation and the American Shoulder and Elbow Surgeons-Elbow form capture aspects of functioning that are important to patients with elbow injuries. *J Hand Ther* 2021;34:415-422.
16. Beaton DE, Wright JG, Katz JN. Development of the QuickDASH: Comparison of three item-reduction approaches. *J Bone Joint Surg Am* 2005;87(5):1038-1046.
17. Wickman JR, Lau BC, Scribani MB, Wittstein JR. Single Assessment Numeric Evaluation (SANE) correlates with American Shoulder and Elbow Surgeons score and Western Ontario Rotator Cuff index in patients undergoing arthroscopic rotator cuff repair. *J Shoulder Elbow Surg* 2020;29:363-369.