Annals of Case Reports
Buttacavoli FA and Williamson TK. Ann Case Rep: 10: 102170
www.doi.org/10.29011/2574-7754.102170
www.gavinpublishers.com

OPEN ACCESS

GAVIN PUBLISHERS

Case Report

The Application of Hydrolyzed Collagen Powder for Prevention of Incisional Wound Complications in Morbidly Obese Patients Undergoing Direct Anterior Approach to Total Hip Arthroplasty: A Clinical Case Series

Frank A Buttacavoli*, Tyler K Williamson

Department of Orthopaedic Surgery, University of Texas Health San Antonio, San Antonio, TX, USA

***Corresponding author**: Frank A Buttacavoli, Department of Orthopaedic Surgery, University of Texas Health San Antonio, 7703 Floyd Curl Drive, San Antonio, TX, USA

Citation: Buttacavoli FA, Williamson TK (2025) The Application of Hydrolyzed Collagen Powder for Prevention of Incisional Wound Complications in Morbidly Obese Patients Undergoing Direct Anterior Approach to Total Hip Arthroplasty: A Clinical Case Series. A Case Report. Ann Case Report. 10: 2170. DOI:10.29011/2574-7754.102170

Received: 22 January 2025, **Accepted:** 27 January 2025, **Published:** 29 January 2025

Abstract

Introduction: Given the anatomic location and tissue layer structure at the incision site, studies have found wound complications to be more prevalent following the direct anterior approach (DAA) to traditional approaches in total hip arthroplasty (THA), citing obesity as a factor further increasing risk. The purpose of this study is to highlight the technique for placement of hydrolyzed collagen in an initial series of morbidly obese patients undergoing DAA-THA.

Methods: Patients undergoing primary DAA-THA with a preoperative body mass index (BMI) >40 kg/m2 were included. During this procedure, intraoperative in-situ placement of a hydrolyzed collagen powder, CellerateRX® Surgical Powder was applied over the fascial closure and before incisional closure to prevent wound dehiscence. Median and Interquartile Range (IQR) statistics were calculated for demographics and surgical details. Subsequent two-week, six-week, and three-month follow-ups were recorded.

Results: Four high-risk patients underwent DAA-THA. No patient exhibited signs of either surgical site infection (SSI) or PJI at the initial follow-up, and all patients achieved complete incisional healing during the 3-month follow-up period.

Conclusion: Intraoperative placement of a sterile hydrolyzed collagen powder between fascial and skin layers is a safe and efficient addition to direct anterior total hip arthroplasty with the potential to accelerate wound healing and eliminate potential space, leading to less seroma formation and superficial surgical site infection.

Keywords: Total Hip Arthroplasty; Direct Anterior; Wound Dehiscence; Periprosthetic Joint Infection; Hydrolyzed Collagen; Obese.

Introduction

Total hip arthroplasty has proven to be among the most clinically efficacious procedures performed by orthopaedic surgeons, with patients achieving noticeable clinical improvement in upwards of 95% [1,2]. Implant modifications, further understanding of alignment and kinematics, patient selection, and enhanced surgical techniques with more attentive consideration of soft tissue and releases over the past decade are some of the main drivers for improving outcomes following total joint arthroplasty [3,4]. However, a subset of patients still do not meet a satisfactory outcome and require revision. Periprosthetic joint infection (PJI) occurs at a relatively low rate following THA (0.1%) but remains a common indication for revision of THA (15.1% of all revisions) [5]. Despite the advances in preventative techniques, operative protocols, and our understanding of its development, rates of PJI have not decreased chronologically, and the number of total joint revision procedures is expected to increase over 170% by 2030 [6,7]. Wound dehiscence following THA remains a concern as it often requires additional irrigation and debridement and potentially propagates space for seroma formation and possible infection risk [8,9].

Several factors have been linked to increased risk of wound dehiscence and PJI, most namely obesity [8-10]. Increased adiposity has shown to disrupt the organization of type 1 and 3 collagen, necessary, leading to decreased tensile and yield for proper wound healing [11-13]. This disruption has been found to increase rates of wound complications when utilizing the direct anterior approach (DAA) to THA, citing the proximity to the waist crease in patients with a pannus [10,14]. Given the hygiene and potential contamination in this anatomical location, failure of the skin barrier following DAA-THA is of utmost concern.

With this in mind, it is imperative to employ preventative measures within direct anterior primary procedures to mitigate this worrisome complication, especially in those patients already at significant risk for wound-healing complications. In this case series of four patients undergoing DAA total hip arthroplasty, we highlight the intraoperative application of Type 1 bovine hydrolyzed collagen powder between the fascial and incisional closure in a cohort with morbid obesity. We surmise the application of hydrolyzed collagen will be safe, surgeon-friendly, and effective in reducing wound-healing complications in this population by three-month follow-up.

MATERIALS AND METHODS

Study Design

This was a retrospective study of patients treated with the direct anterior approach THA at our hospital between May 2024 and August 2024. The study was approved by the ethics committee of our hospital.

Inclusion and Exclusion Criteria

The inclusion criteria for our study were primary total hip arthroplasty with preoperative BMI greater than 40 kg/m2. Patients with previous periprosthetic joint infection in a contralateral joint and those with previous instrumentation or surgical intervention (excluding arthroplasty) on the operative joint were not excluded. All cases are documented in Table 1.

Standard Operation Protocol

All 4 cases were operated on by four resident orthopaedic surgeons and one chief orthopaedic surgeon with more than 10 years of experience, with the assistance of an advanced provider. All procedures were conducted in a single stage within an operating room equipped with vertical laminar airflow and an accompanying sub-sterile entry room, ensuring a controlled sterile environment. Furthermore, all surgeries were performed by the same surgeon, maintaining consistency in surgical technique and protocol adherence across the study. Intraoperative antibiotics (all were given cefazolin 2 grams) were used 30 minutes before the first skin incision and every 8 hours following for 24 hours. Each patient was given 1-gram tranexamic acid to start the case, and one more gram was given shortly before closure. Each hip or knee prosthesis inserted was of the same company (Zimmer, Warsaw, IN, USA). The type of prosthesis, modularity, and constraint was patient-specific and decided upon by the chief orthopaedic surgeon.

Product Description

The CellerateRX® Surgical Powder (Sanara MedTech, Inc., Fort Worth, Texas) is an FDA-cleared surgical powder indicated for the management of surgical wounds, traumatic wounds, partial- and full-thickness wounds, and first- and second-degree burns (Figure 1) [15-17].

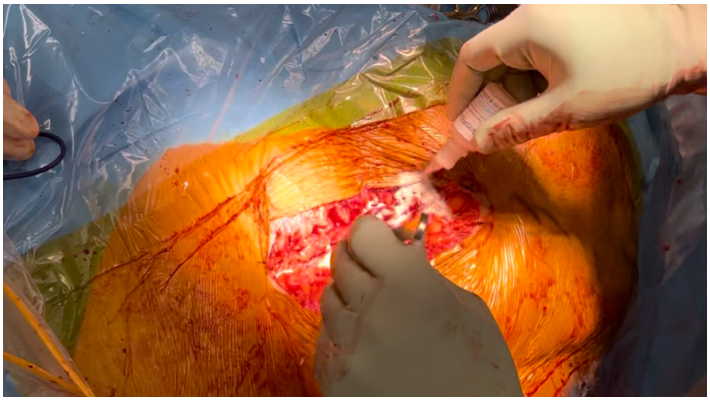

Figure 1: CellerateRx® Surgical Powder in a Direct Anterior Incisional Wound.

The CellerateRX is a soluble, small molecular size collagen powder composed of hydrolyzed, fragmented collagen presented to the body in a ready-to-use form rather than the large molecule, insoluble triple-helix native collagen. The primary mechanism of this powder is to support extracellular matrix (ECM) formation and promote anti-inflammatory signalling allowing for cell proliferation and migration to expedite wound healing. The expedited wound healing is theorized to decrease potential spaces for fluid collection and, therefore, less seroma, hematoma, and superficial surgical site infections.

Total Hip Application Technique

Each patient undergoing total hip arthroplasty was placed into a supine position on an orthopaedic fracture table with bony prominences well padded. A direct anterior incision was performed, and implants were trialed and placed in a press-fit fashion. After fascial closure, a bottle of CellerateRXTM surgical powder (a 1-gram bottle for surface areas with coverage less than 210 cm^2 and 5-gram for those greater than 1000 cm^2 surface area) was placed in a light dusting fashion over the fascial closure and subcutaneous overlying tissue (Figures 2A-2B). The product usage quantity recommendation does not account for wound depth, which may adjust the amount needed for appropriate coverage per the surgeon's judgment. A layered closure was performed with staples. Sterile negative pressure wound vacuum dressings were placed. Each patient was made weightbearing as tolerated immediately following the procedure. All patients had a 13-cm, 14-day negative pressure incisional wound therapeutic device placed sterile in the OR, were made weightbearing as tolerated postoperatively, worked with physical therapy post-operative day 1 and received assistive ambulatory equipment prior to discharge, and were discharged on 81 mg aspirin for VTE chemoprophylaxis.

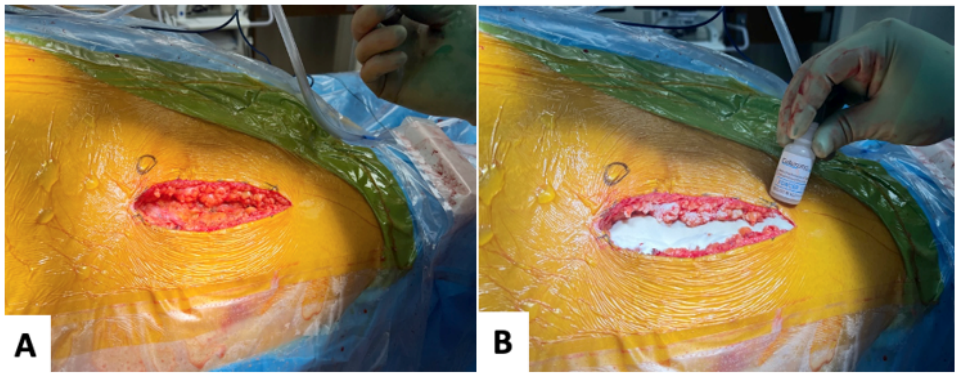

Figure 2A: Direct anterior approach with fascial closure before powder placement – Figure 2B. Anterior incisional wound after placement of a 5-gram bottle of CellerateRX® surgical powder over fascial closure and into the subcutaneous tissue.

Follow-up

After surgery, in-patient physical therapy, and discharge, all 4 patients were followed up clinically and radiologically at two weeks, six weeks, and three months postoperatively.

Statistical Analysis

Skewed distributed data were expressed as median (range). SPSS 29.1 (IBM, Armonk, NY, USA) was used for analysis.

RESULTS

Cohort Overview

There were 4 patients included in our initial experience with the CellerateRX® Surgical Powder. All four patients were undergoing primary total hip arthroplasty. The list of demographic and patient-specific factors related to their diagnosis and surgical indication is available in Table 1. All four patients required inpatient admission [median: 2 days; range 0-5 days]. Signs of infection at the first postoperative appointment (between 10 to 20 days) were absent in all 4 patients, all sutures/staples were removed, and all wounds remained aseptic and fully healed by the 6-week follow-up appointment.

Patient No.	Age	Sex	BMI	Comorbidities	Surgical History	Prior History of Infection	Surgery	EBL
1	59	M	46.52	Type 2 Diabetes (T2DM), Chronic Kidney Disease stage 3 (CKD3), Hyperlipidemia (HLD)	Right knee arthroscopy	N	Right THA	400
2	68	F	40.32	T2DM, Hypertension (HTN), HLD, lumbar degenerative joint disease (DJD)	Arthroscopic rotator cuff repair	N	Right THA	400
3	38	M	41.53	T2DM, asthma w/ chronic steroid use, HTN	None	N	Left THA	300
4	56	F	44.32	T2DM, HTN, gastroesophageal reflux disease (GERD)	None	N	Right THA	500

Table 1: Cohort Overview.

Case 1: Patient No. 1

A 59-year-old female patient with a history of hyperlipidemia, Type 2 diabetes, and stage III chronic kidney disease presented to orthopaedic clinic for a complaint of right hip pain that began four years ago. She stated the pain had worsened over the past six months and, despite steroid and gel intra-articular injections, has not improved. She is only able to walk less than a hundred feet before taking a break. On physical exam, the patient had moderate tenderness to anterior and lateral hip, flexion to 100° and IR of 5°, 4/5 flexion strength, with pulses, sensation, and reflexes intact distally. After surgical clearance, Patient #1 underwent right THA with placement of CellerateRX® Surgical Powder (depicted in Figures 2A-2B) and had an uncomplicated hospital stay, worked well with physical therapy, and was discharged home with home health physical therapy on postoperative day 2. At the first follow-up two weeks postoperatively, the patient demonstrated mild tenderness along the incisions and appeared to be healing well without signs of drainage or dehiscence (depicted in Figures 3A-3B). All staples were removed and steri strips were placed perpendicular over the incision. The patient was followed up at the six-week and three-month mark with fully healed incisions and continuing to work with home health physical therapy.

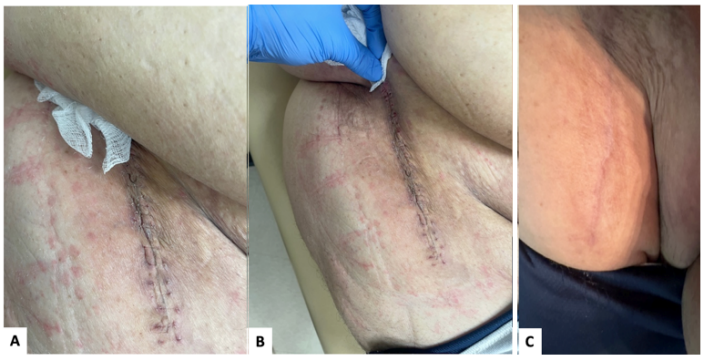

Figure 3A-B: Direct anterior incision of right hip, 2 weeks postoperatively after staple removal Figure 3C. Direct anterior incision of right hip, 6 weeks postoperatively.

Case 2: Patient No. 3

A 38-year-old male patient with a history of Type 2 diabetes, asthma requiring chronic steroid use, and hypertension presented to orthopaedic clinic for the complaint of debilitating left hip pain that had worsened over the past year and, despite steroid and gel

intra-articular injections, has not improved. He has been unable to continue his job as a bartender due to his hip pain. On physical exam, the patient had minimal active motion of the left hip with significant groin pain. Preoperative radiographs and computed tomography (CT) scan of avascular necrosis of the left femoral head. After surgical clearance and discussion of the risks and benefits, the patient elected to undergo left total hip replacement. Patient #3 underwent left THA via a direct anterior approach with the placement of CellerateRX®. He had an uncomplicated hospital stay, worked well with physical therapy, and was discharged home with home health physical therapy on postoperative day 4. At the first follow-up two weeks postoperatively, the patient was very happy with his surgical outcome, walking without assistance. He elicited no tenderness along the incision, and it appeared to be healing well without signs of drainage or dehiscence. All staples were removed, and steri strips were placed perpendicularly over the incision. The patient was followed up at the six-week and three-month mark with fully healed incisions (Figure 4) and continuing to work with home health physical therapy with plans to return to work after the next follow-up visit.

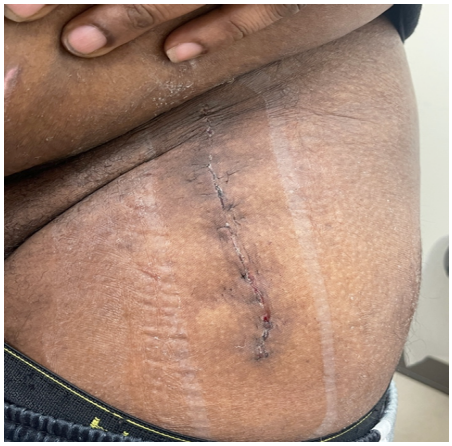

Figure 4: Direct anterior incision of left hip, 2 weeks postoperatively.

Discussion

Periprosthetic joint infection has been shown to occur at rates of 0.1-0.3% following THA [6]. However, due to the increasing number of joint arthroplasty procedures performed per year and the steady rate of PJI incidence despite our increasing understanding of its development, the number of revision surgeries for PJI is expected to exponentially increase in the coming years [9]. Therefore, implementing strategies to optimize patients before joint arthroplasty and taking additional measures to mitigate wound-related factors leading to PJI, especially in those at greater risk, can prove to be both beneficial financially and from a quality-of-life standpoint for the patient. The CellerateRX® Surgical Powder has demonstrated superior wound-healing capabilities across a variety of different surgical specialties [15-17]. In this cohort of four at-risk morbidly obese patients undergoing direct anterior total hip arthroplasty, the application of hydrolyzed collagen powder between the fascial and skin closures to support timely wound healing and prevent wound dehiscence, dampening the opportunity for complications such as seroma formation and development of periprosthetic infection.

Numerous patient-specific risk factors have been associated with the development of wound dehiscence following THA, especially in obese patients undergoing the direct anterior approach (DAA) [14,18-20]. Given the increased pannus encountered in these patients, the anatomical difficulties as well as the hygienic concern and proximity to the genital area in addition place the direct anterior incision at risk for both healing and infectious complications. The CellerateRX® Surgical Powder had an intended use in the realm of wound therapy to present ready-to-use hydrolyzed collagen to the body for incorporation and increase the likelihood of incisional cross-bridge formation even in patients with decreased wound-healing potential [21,22].

Comorbidity risk can often be compounded by other factors that further enhance the risk for postoperative PJI. While morbid obesity itself is an isolated risk factor for complications after primary total hip arthroplasty, patients in our case series also exhibited relevant comorbidities that placed them at further risk for wound healing and infectious complications [23]. All four patients in our series were being treated for Type 2 diabetes with hemoglobin A1c ranging from 6.4 to 7.8. Although their A1c was within an appropriate range to be indicated for total hip arthroplasty, this condition still places patients at risk, as HbA1c may not effectively predict infection after THA [24,25]. In addition, studies have shown Type II Diabetes Mellitus alone may be more predictive of infection after THA than differing surgical approaches, as well as chronic kidney disease [26,27]. Surgical indication for elective THA may also play a role in the development of complications, as those other than osteoarthritis are associated with increased healthcare resource utilization [28,29]. The heightened risk of these presentations lends justification for the incorporation of preventative supplements during total hip procedures to enhance wound healing and minimize infection risk. The CellerateRX® Surgical Powder product may provide an additional tool to enhance the surgeon experience and outcomes of a direct anterior approach to total hip arthroplasty. In addition, implementation of its use fits seemingly into current intraoperative protocols, which as a bundle with NPWT in this case series may be adjunctive in reducing complications, especially in a cohort of patients that are often denied surgical intervention due to their increased risk of both wound and infection-related complications.

Limitations

The present study is not without limitations, particularly related

to the relatively small sample size and retrospective design. The outcomes of a single-surgeon cohort may limit the generalizability of our findings due to potential biases from patient selection and both choice and skill of operative techniques employed. The primary limitation of this evaluation is the noncomparative and small design; as a result, statistical analysis was unable to be performed. A larger study with a cohort match is warranted to definitively establish the efficacy of the hydrolyzed collagen powder in preventing both wound-healing complications and surgical site and periprosthetic joint infection. Similar studies of a multi-center design, with a much larger population, will be most appropriate to further investigate the results of the present study.

Summary

Impaired wound healing continues to occur at constant rates across total hip arthroplasty, especially in obese patients, despite our increased understanding of its incidence and risk factors associated with its development. In the present study, intraoperative placement of a hydrolyzed collagen powder following fascial closure is a safe and efficient addition to a total hip replacement through the direct anterior approach with the potential to limit space-occupying fluid collections and incidence of both surgical site and periprosthetic joint infections.

Ethical review committee statement: Institutional Review Board approval was obtained before enrolling patients in the database. Informed consent was obtained from each patient prior to enrolment.

References

1. Muthusamy N, Lygrisse KA, Sicat CS, Schwarzkopf R, Slover J, et al (2023) The Effect of Surgeon and Hospital Volume on Total Knee Arthroplasty Patient-reported Outcome Measures: An American Joint Replacement Registry Study. J Am Acad Orthop Surg. 31:1026-1031.
2. Bloom DA, Manjunath AK, Gualtieri AP, Fried JW, Schwarzkopf RM, et al (2021) Patient Satisfaction After Total Hip Arthroplasty Is Not Influenced by Reductions in Opioid Prescribing. J Arthroplasty. 36:S250-S257.
3. Marsh M, Newman S. (2021) Trends and developments in hip and knee arthroplasty technology. J Rehabil Assist Technol Eng. 8:2055668320952043.
4. Rueckl K, Springer B, Jungwirth-Weinberger A, Bechler U, Kasparek MF, et al (2022) A standardized soft tissue release technique to lower the risk of greater trochanteric fractures for the anterior approach in total hip arthroplasty. Arch Orthop Trauma Surg. 142:3067-3073.
5. Patel I, Nham F, Zalikha AK, El-Othmani MM. (2023) Epidemiology of total hip arthroplasty: demographics, comorbidities and outcomes. Arthroplasty. 5:2.
6. Parvizi J, Tan TL, Goswami K, Higuera C, Della Valle C, et al (2018) The 2018 Definition of Periprosthetic Hip and Knee Infection: An Evidence-Based and Validated Criteria. J Arthroplasty. 33:1309-1314. e2.
7. Schwartz AM, Farley KX, Guild GN, Bradbury TL Jr. (2020) Projections and Epidemiology of Revision Hip and Knee Arthroplasty in the United States to 2030. J Arthroplasty. 35:S79-S85.
8. Purcell RL, Parks NL, Cody JP, Hamilton WG. (2018) Comparison of Wound Complications and Deep Infections With Direct Anterior and Posterior Approaches in Obese Hip Arthroplasty Patients. J Arthroplasty. 33:220-223.
9. Statz JM, Duethman NC, Trousdale RT, Taunton MJ. (2019) Outcome of Direct Anterior Total Hip Arthroplasty Complicated by Superficial Wound Dehiscence Requiring Irrigation and Debridement. J Arthroplasty. 34:1492-1497.
10. Watts CD, Houdek MT, Wagner ER, Sculco PK, Chalmers BP, et al (2015) High Risk of Wound Complications Following Direct Anterior Total Hip Arthroplasty in Obese Patients. J Arthroplasty.:2296-8.
11. Goodson WH, III, Hunt TK. (1982) Development of a new miniature method for the study of wound healing in human subjects. Journal of Surgical Research. 33:394–401.
12. Ganeshkumar M, Ponrasu T, Krithika R, Iyappan K, Gayathri VS, et al (2012) Topical application of Acalypha indica accelerates rat cutaneous wound healing by up-regulating the expression of Type I and III collagen. Journal of Ethnopharmacology. 142:14–22.
13. Pierpont YN, Dinh TP, Salas RE, Johnson EL, Wright TG, et al (2014) Obesity and surgical wound healing: a current review. ISRN Obes. 2014:638936.
14. Purcell RL, Parks NL, Gargiulo JM, Hamilton WG. (2016) Severely Obese Patients Have a Higher Risk of Infection After Direct Anterior Approach Total Hip Arthroplasty. J Arthroplasty. 31:162-5.
15. Nowrouzi R, Awad SS. (2023) Activated Collagen Powder Significantly Reduces Surgical Site Infections in Patients Undergoing Elective Surgery. J Surg 8: 1918.
16. Gitelman A. (2022) The Use of Sterile Bovine Type 1 Hydrolyzed Collagen to Support Surgical Wound Management: A Case Series. JSM Neurosurg Spine 9: 1108.
17. Evans DC, Evans BG. (2018) The Effects of Platelet-Rich Plasma and Activated Collagen on Wound Healing in Primary Total Joint Arthroplasty. Orthopedics. 41:e262-e267.
18. Revelt N, Sleiman A, Kurcz B, George E, Kleinsmith R, et al (2024) Acute Surgical Site Complications in Direct Anterior Total Hip Arthroplasty: Impact of Local Subcutaneous Tissue Depth and Body Mass Index. Arthroplast Today. 28:101465.
19. Jahng KH, Bas MA, Rodriguez JA, Cooper HJ. (2016) Risk Factors for Wound Complications After Direct Anterior Approach Hip Arthroplasty. J Arthroplasty. 31:2583-2587.
20. Sun X, Zhao X, Zhou L, Su Z. (2021) Direct anterior approach versus posterolateral approach in total hip arthroplasty: a meta-analysis of results on early post-operative period. J Orthop Surg Res. 16:69.
21. León-López A, Morales-Peñaloza A, Martínez-Juárez VM, Vargas-Torres A, Zeugolis DI, et al (2019) Hydrolyzed Collagen-Sources and Applications. Molecules. 24:4031.
22. Mbese Z, Alven S, Aderibigbe BA. (2021) Collagen-Based Nanofibers for Skin Regeneration and Wound Dressing Applications. Polymers (Basel). 13:4368.
23. Matar HE, Pincus D, Paterson JM, Aktar S, Jenkinson R, Ravi B. (2020) Early Surgical Complications of Total Hip Arthroplasty in Patients With Morbid Obesity: Propensity-Matched Cohort Study of 3683 Patients. J Arthroplasty. 35:2646-2651.
24. Chandrupatla S, Rumalla K, Singh JA. (2024) Association between diabetes mellitus and total hip arthroplasty outcomes: an observational study using the US National Inpatient Sample. BMJ Open. 14:e085400.

25. Cancienne JM, Werner BC, Browne JA. (2017) Is There a Threshold Value of Hemoglobin A1c That Predicts Risk of Infection Following Primary Total Hip Arthroplasty? J Arthroplasty. 32:S236-S240.

26. Carlock KD, Wilkerson JB, Yamaguchi JT, Fernando ND. (2024) A Comparison of Wound Complications Following Total Hip Arthroplasty Performed Through the Direct Anterior Versus Direct Lateral Approach. Arthroplast Today. 27:101388.

27. Fox JA, Domingue GA, DeMaio CV, Brockman BS, Malloy K, et al (2023) Total hip arthroplasty complications in patients with chronic kidney disease: A comparison study. J Orthop. 39:1-6.

28. Sax OC, Pervaiz SS, Douglas SJ, Remily EA, Mont MA, et al (2021) Osteoarthritis and Osteonecrosis in Total Hip Arthroplasty: 90-Day Postoperative Costs and Outcomes. J Arthroplasty. 36:2343-2347.

29. Blackburn CW, Du JY, Marcus RE. (2024) Elective THA for Indications Other Than Osteoarthritis Is Associated with Increased Cost and Resource Use: A Medicare Database Study of 135,194 Claims. Clin Orthop Relat Res. 482:1159-1170.