



OPEN ACCESS

EDITED BY

Ming Yan,
Fourth Military Medical University, China

REVIEWED BY

Jiacheng Liu,
First Affiliated Hospital of Chongqing Medical
University, China
Meng Zhang,
Peking University People's Hospital, China

*CORRESPONDENCE

Cong Yang
✉ congyang213@163.com
Jiuqun Li
✉ lijuiqun@sina.com

RECEIVED 13 March 2025

ACCEPTED 22 August 2025

PUBLISHED 05 September 2025

CORRECTED 17 October 2025

CITATION

Ren Y, Yang L, Fan Y, Chen B, Tan Y,
Hu S, Li J and Yang C (2025) Research
progress on the causes and countermeasures
of postoperative swelling in gluteal muscle
contracture.
Front. Med. 12:1592911.
doi: 10.3389/fmed.2025.1592911

COPYRIGHT

© 2025 Ren, Yang, Fan, Chen, Tan, Hu, Li and
Yang. This is an open-access article
distributed under the terms of the [Creative
Commons Attribution License \(CC BY\)](#). The
use, distribution or reproduction in other
forums is permitted, provided the original
author(s) and the copyright owner(s) are
credited and that the original publication in
this journal is cited, in accordance with
accepted academic practice. No use,
distribution or reproduction is permitted
which does not comply with these terms.

Research progress on the causes and countermeasures of postoperative swelling in gluteal muscle contracture

Yuxiang Ren¹, Li Yang¹, Yingyi Fan¹, Bixia Chen², Yanrong Tan¹,
Sha Hu¹, Jiuqun Li^{1*} and Cong Yang^{1*}

¹Shenzhen Hospital, Peking University, Shenzhen, China, ²College of Medicine, Shantou University, Shantou, China

Surgical site swelling represents a prevalent complication following gluteal contracture release that adversely impacts functional recovery; while current literature predominantly focuses on rehabilitation outcomes, insufficient attention has been paid to swelling etiology. This review synthesizes causative evidence across three determinant categories: (1) preoperative factors—individual variations in coagulation profiles and symptom severity; (2) intraoperative variables—technical disparities in hemostasis, surgical trauma magnitude, and irrigation parameters; (3) postoperative divergences—inconsistent compression bandaging, exercise initiation timing, education quality, and compliance. Critical preventive strategies include implementing comprehensive preoperative education, standardizing surgical protocols, instituting graded rehabilitation, and establishing early detection-intervention frameworks, which collectively reduce swelling incidence and severity. These evidence-based approaches offer optimized clinical pathways while informing future research.

KEYWORDS

gluteus contracture, swelling, hematoma, nursing, summary

1 Introduction

Gluteal muscle contracture (Gluteal muscle contracture, GMC) is a distinct clinical condition marked by the abnormal shortening and tightening of the gluteal muscles, tensor fascia lata (TFL), iliotibial band (ITB), and associated fascia. This condition can lead to restricted movement and discomfort, particularly affecting the external rotation of the hip joint (1). While GMC is a global issue, it exhibits a higher prevalence in China, primarily affecting infants and adolescents (2). Most patients have a history of frequent buttock injections during their early years, with an estimated childhood incidence rate ranging from 1 to 2.5% (3, 4). Currently, both domestically and internationally, the standard treatment for gluteal muscle contracture is the gluteal muscle contracture release surgery. This surgical approach demonstrates distinct advantages over traditional methods and has gained widespread clinical adoption (5). Studies indicate that arthroscopic hip muscle contracture release has become the gold standard globally for treating this condition (6, 7).

Postoperative symptoms such as hematoma and swelling following gluteal muscle contracture surgery can lead to adverse outcomes, including pain, infection, and necrosis, thereby prolonging recovery time and increasing treatment costs (8). Although most literature suggests that postoperative hematoma is typically transient, targeted interventions are still necessary to mitigate potential complications. Studies indicate that postoperative hematomas can lead to severe complications, causing not only pain but also potential nerve damage, which

in turn prolongs recovery time and increases treatment complexity and costs (9, 10). The assessment of postoperative hematomas is essential. Studies have suggested two classification methods for surgical wound hematomas after total hip arthroplasty, with the objective classification based on measuring hematoma area demonstrating greater reliability (11). This approach offers a useful reference for evaluating muscle contracture hematomas following hip replacement. Precise assessment enables clinicians to develop more targeted treatment strategies, reducing adverse effects such as swelling and lowering the risk of complications like infection and necrosis. Ultimately, this method shortens recovery time and helps manage treatment costs.

In conclusion, the risks of hematoma and swelling following gluteal muscle contracture surgery should not be underestimated. Although most postoperative hematomas are temporary, clinicians must adopt targeted measures to alleviate patient discomfort, reduce complication rates, accelerate recovery, and lower treatment costs. These measures include optimizing surgical techniques to prevent complications, conducting precise hematoma assessments, and implementing timely interventions. This study reviews the literature to analyze the causes of swelling following gluteal muscle contracture surgery. Targeted solutions are proposed based on these causes, aiming to provide scientific evidence for clinical treatment, optimize therapeutic strategies, effectively reduce postoperative swelling, promote recovery, and enhance the patient's quality of life.

2 Basic theories of postoperative swelling in gluteal muscle contracture

2.1 Pathophysiology of gluteal muscle contracture

Gluteal muscle contracture (GMC) is a chronic fibrotic disease of the gluteal muscles with multiple etiologies. Research has shown that in GMC tissues, compared to normal muscle tissues, there are significant changes at the molecular and cellular levels. For instance, the protein and mRNA expression of Emilin 1 are decreased, while miR - 491 - 5p shows an aberrant elevation, and these two are negatively correlated (12). The direct binding of miR - 491 - 5p to Emilin 1 mRNA, as confirmed by luciferase reporter gene assay, leads to the inhibition of Emilin 1 expression. This, in turn, promotes the proliferation and fibrosis of contraction band (CB) fibroblasts via the TGF - β 1/Smad3 signal axis.

FKBP prolyl isomerase 10 (FKBP10) also plays a key role in GMC progression. In the gluteal muscle of GMC patients and rats, FKBP10 expression is up - regulated, accompanied by obvious tissue damage and fibrosis. Elevated levels of TGF β 1, α - SMA, collagen I, collagen III, vimentin, fibronectin, p62, and LC3, along with decreased levels of MMP9 and LC3II/I, Beclin 1, p62, and ATG7, indicate weakened autophagy (13). The interaction between FKBP10 and HSP47 further inactivates the HSP47/SMAD3 signaling pathway, which is crucial in the development of GMC.

2.2 Mechanisms of postoperative swelling

The mechanisms of postoperative swelling in gluteal muscle contracture are complex and multifactorial. Inflammation is a

common contributing factor. After surgery, the body's immune response is activated, leading to the release of pro - inflammatory cytokines such as interleukin 1 β (IL - 1 β), interleukin 18 (IL - 18), and tumor necrosis factor α (TNF - α) (14). These cytokines can increase vascular permeability, allowing fluid to leak into the interstitial space and cause swelling.

Another aspect is related to the disruption of blood vessels during surgery. Inosculation of blood vessels is important for the early perfusion and vitality of tissues. However, if the normal process of vascular inosculation is disrupted, it may lead to ischemia in the surgical area, followed by reperfusion injury, which can also contribute to swelling (15). Additionally, factors such as fluid overload, exogenous opioids, neurohormonal dysfunction, and gastrointestinal stretch and inflammation, which are key mechanisms in the pathophysiology of postoperative ileus in general surgeries, may also play a role in the postoperative swelling of gluteal muscle contracture surgeries (16).

3 Analysis of the causes of postoperative swelling in the surgical area

3.1 Preoperative individual differences

Preoperative coagulation function and the severity of patient symptoms directly influence surgical outcomes and postoperative swelling. Patients with poor coagulation function require more extensive preoperative preparation. Intraoperative trauma can damage the vascular endothelial tissue, impairing venous blood flow and resulting in reduced postoperative activity compared to preoperative levels. This can lead to slow blood circulation, making patients more susceptible to bruising and severe swelling (17). Shrestha et al. classified gluteal contracture into four types based on the hip inversion angle during 90° hip flexion and 90° knee flexion: type I (−5° to −20°), type II (−20° to −40°), type III (−40° to −60°), and type IV (> −60°). As the degree of hip inversion increases, clinical symptoms worsen, making surgery more challenging and outcomes less favorable (17, 18). This classification method is valuable for predicting preoperative surgical outcomes.

3.2 Critical intraoperative procedures

3.2.1 Degree of subcutaneous adipose tissue removal

During arthroscopic release of gluteal contracture, the creation of an operative space between the subcutaneous adipose layer and the fibrous contracture bands requires precise dissection. Inadequate debridement of adipose tissue may obscure the arthroscopic view, increasing the risk of iatrogenic injury to neurovascular structures (19). Conversely, excessive adipose destruction can damage the vascularized gluteal fascia and underlying muscle fibers, triggering inflammatory exudation that predisposes to postoperative hematoma or seroma formation (20). Furthermore, when the gluteal contracture band is located in deep anatomical layers or when uncontrolled intraoperative hemorrhage compromises arthroscopic visualization, conversion

to open surgery may be necessitated for safety preservation (21). However, open approaches require extensive surgical dissection, resulting in significantly higher intraoperative blood loss (mean: 185 ± 32 mL vs. 45 ± 15 mL in arthroscopy) (22). The limited tactile feedback and optical resolution in distinguishing neurovascular structures under direct visualization increase susceptibility to iatrogenic injury, particularly to the superior gluteal neurovascular bundle traversing the intermuscular plane (23).

3.2.2 Intraoperative irrigation

Management Continuous high-volume irrigation is essential for maintaining a clear surgical field during arthroscopic gluteal contracture release. However, excessive irrigation fluid absorption may induce localized tissue swelling and postoperative gluteal pain (24). The primary complication stems from fluid extravasation into interstitial spaces, where an elevated extracellular osmotic gradient (>290 mOsm/L) relative to intracellular levels triggers fluid influx into cells, causing intraoperative cellular edema (25). As detailed below, elevated perfusion pressure (>40 mmHg) disrupts fluid homeostasis through a triple cascade: (1) It directly increases capillary hydrostatic pressure (P_c) and dilutes plasma colloid osmotic pressure (π_p), overriding Starling forces to drive fluid extravasation; (2) Hyperosmotic irrigants (>290 mOsm/L) induce transmembrane osmotic shock, triggering cellular edema via ENaC-mediated water influx and impairing post-reversal membrane repair; (3) Mechanotransduction (Piezo1/ Ca^{2+} -VEGF axis) and inflammatory mediators further degrade endothelial barrier integrity, perpetuating protein-rich fluid accumulation. These mechanisms collectively elucidate how pressure disrupts osmotic equilibrium and exacerbates tissue swelling (26). Postoperatively, reversal of this osmotic gradient facilitates fluid extravasation from damaged cells into the periarticular tissue space. Given the higher density of periarticular connective tissue compared to joint cavities, elevated irrigation pressures (>40 mmHg) are often required for adequate visualization during microscopic dissection (27). Nevertheless, such pressures directly correlate with interstitial fluid accumulation, exacerbating tissue edema through mechanotransduction-mediated vascular permeability enhancement.

3.2.3 Intraoperative hemostasis

Extensive release of fibrotic bands in gluteal contracture necessitates significant dissection through normal muscular tissue, resulting in postoperative gluteal weakness and elevated risk of neurovascular injury within the gluteal compartment (25). The retraction of transected contracture tissues creates inevitable dead spaces, while the highly vascularized gluteal fascia predisposes to intraoperative damage of gluteus maximus fibers. Consequently, persistent wound bleeding occurs due to incomplete intraoperative hemostasis (28). Furthermore, the combination of a deep surgical field with limited access, residual irrigation fluid accumulation, traumatic exudation, and ineffective postoperative drainage (e.g., tube obstruction) promotes hematoma formation. If such hematomas organize into fibrin-rich clots triggering scar contracture, surgical re-intervention may be required (29).

3.3 Timing of postoperative functional exercise

Premature postoperative mobilization may exacerbate pain, swelling, and inflammatory exudates at the surgical site by amplifying tissue inflammatory responses and increasing hemorrhage risk. A bidirectional interaction exists between pain and edema, mediated by the body's stress response: pain stimulates neuroendocrine release of catecholamines and cortisol, which enhance vascular permeability and aggravate tissue edema (30). Conversely, edema compromises microcirculation and induces mechanical compression of neural structures, thereby intensifying pain perception and impeding functional recovery (4).

3.4 Patients' knowledge and beliefs

Insufficient understanding of postoperative recovery principles combined with outcome overexpectation frequently leads to non-adherence to graded rehabilitation protocols. Premature initiation of high-intensity exercises potentiates risks of periarticular soft tissue injury and hematoma formation (31). Biomechanical analysis indicates that elevated suture tension at the distal surgical site—when compounded by aggressive internal rotation maneuvers or uncontrolled hip flexion during the early healing phase—may induce wound deformation. This mechanical stress disrupts microvascular integrity, resulting in inflammatory exudation, expanding hematomas, and delayed tissue healing.

4 Postoperative swelling countermeasures in the surgical area

4.1 Preoperative physical examination to assess the surgical area

Gluteal contracture release is predominantly performed using arthroscopic techniques, which are characterized by minimal muscle tissue dissection, reduced trauma, and limited exposure (32). Consequently, a thorough preoperative physical examination is essential to assess the extent of the contracture. The surgical area can be divided into a grid pattern based on the anatomical surface projection of the hip, with key anatomical structures marked for surgical guidance (33). This approach helps the surgeon to better understand the local neurovascular anatomy, allowing for the design of a personalized surgical plan that significantly reduces the risk of nerve and blood vessel injury.

4.2 Intraoperative avoidance of inadvertent injury to normal muscle fibers and reduction of bleeding

To ensure successful surgery, it's crucial to minimize bleeding and maintain a clear surgical field. We carefully select the surgical approach, site, and access, avoiding damage to normal muscle fibers, the sciatic nerve, and supragluteal vessels and nerves. The procedure progresses from superficial to deep, cutting contracture bands and bundles

obliquely and precisely under a microscope (34). We repeatedly check signs like the “cross-legged sign” and hip popping for complete release. Using 1 mg of epinephrine per 3 L of perfusion solution for continuous flushing helps reduce bleeding and drainage, keeping the field clear and preventing accidental nerve and vessel injury (35).

In gluteal muscle contracture surgery, the blunt puncture head creates a small cavity, requiring the surgeon to be well-versed in anatomy, skilled in arthroscopic techniques, and adept at three-dimensional spatial thinking. The area around the greater trochanter, where the gluteus maximus, iliotibial fascia, and tensor fasciae latae attach, is often targeted for surgical release. Some studies suggest that a modified arthroscopic approach using an “L” or “C” shaped release path around the greater trochanter can minimize subcutaneous separation, reduce neurovascular injury, expand the release area, and speed up recovery (36). This technique involves a minimally invasive excision of the contracture zone with selective release around the greater trochanter, showing good surgical outcomes.

4.3 Intraoperative reduction or avoidance of extravasation of irrigation fluid

Accumulation of irrigation fluid in gluteal tissues contributes to postoperative swelling and pain; strict control of irrigation volume and pressure minimizes fluid extravasation into interstitial spaces, thereby reducing hematoma formation. Maintaining appropriate irrigation pressure is critical since insufficient pressure impairs hemostasis, while excessive pressure promotes tissue edema. To sustain consistent cavity pressure, surgical nurses must continuously monitor fluid flow rates and replenish supplies promptly—supported by evidence from shoulder arthroscopy where perfusion pressures reach 50 mmHg (peaking transiently at 120 mmHg) yet normalize within 4–30 min without inducing myofascial compartment syndrome or compromising muscle perfusion (37). Optimal management therefore combines controlled irrigation flow/pressure with postoperative drainage to mitigate swelling from fluid leakage; nevertheless, evidence defining perfusion pressure parameters for gluteal surgery remains limited, and no standardized pressure range exists, warranting further investigation.

4.4 Effective hemostasis and adequate drainage during the perioperative period

Inadequate hemostasis or drainage exacerbates postoperative swelling. Effective physical hemostasis includes direct compression and pressure bandaging. Adjunctive cold therapy reduces surgical site bleeding, while layered dressings and positional changes (supine/lateral rotation) prevent hematoma formation (38). Improved compression techniques—such as external wound placement of sandbags secured with abdominal binders—enhance hemostatic efficacy compared to standard sandbag compression.

Compression garments (e.g., elastic pants) provide targeted pressure with improved comfort and mobility, concurrently mitigating rehabilitation pain and preserving patient dignity. Pharmacological approaches, notably topical tranexamic acid applied perioperatively to soft tissues, significantly reduce bleeding, exudate, and swelling,

particularly in early postoperative stages (39). Effective drainage mitigates postoperative hematoma risk by evacuating accumulated blood from deep cavities formed by retracted transected tissues during gluteal contracture release—a condition characterized by narrow openings that impair natural drainage. Key interventions include suturing the deep fascial superficial layer to reduce tension, placing drainage tubes into cavity depths to prevent infection and adhesions, and applying negative pressure to maintain tissue apposition for internal hemostasis without increasing blood loss (5).

Synergistic hemostatic approaches beyond conventional methods significantly mitigate hematoma risk. Clinical evidence confirms that adrenaline-infused pumps (0.1% HCl epinephrine) at surgical sites stabilize perioperative circulation and prevent hematoma formation (40). Given that occult blood loss drives postoperative complications—including hematomas, tissue swelling, and pain—combined interventions yield multiplicative benefits: plasma knife coagulation followed by topical tranexamic acid (TXA) in the operative cavity, drainage tube clamping for 3 h post-TXA application, protocolized systemic TXA dosing (20 mg/kg preoperatively; 10 mg/kg at 3- and 6-h intervals), intraoperative TXA-soaked gauze for 10 min before closure, and 24-h compression bandaging collectively reduce blood loss and surgical site morbidity (39).

Therefore, meticulous hemostasis and drainage management are imperative. Early intraoperative pressure bandaging should be applied, with vigilant maintenance of drainage tube patency and surgical site cleanliness. Clinicians must routinely assess and document drainage characteristics (color, viscosity, volume), while instructing patients on position changes to prevent tube dislodgement or compression-induced occlusion.

4.5 Reduce or avoid early high-intensity exercise after surgery

Early postoperative mobilization prevents joint adhesions, however, premature high-intensity exercise risks surgical site disruption, exacerbating inflammation, hemorrhage, pain, and swelling. Consequently, standardized progressive rehabilitation protocols are essential to prevent contracture recurrence and promote functional hip recovery (41). Patients should initiate graded exercises with incremental intensity increases during healing to avoid iatrogenic injury—evidenced by clinical reports of uncontrolled activity complications: three hematomas within 10 days postoperatively resulted from abrupt hip flexion/extension with knee fixation, requiring emergent ligation of injured circumflex femoral artery branches; another hematoma confirmed by ultrasonography followed 100 consecutive deep squats on postoperative day 3. Although resolved through intervention, these incidents significantly delayed recovery, underscoring the critical balance between early mobility and controlled progression (42).

Consequently, clinical staff should prioritize patient education on postoperative rehabilitation principles, emphasizing the critical importance of progressive overload training—advancing from low-intensity passive to high-intensity active exercises while maintaining respiratory control (41). This approach establishes active-dominant training supplemented by passive modalities. Real-time correction of improper techniques during supervised sessions prevents bleeding, swelling, and soft tissue injuries caused by erroneous

repetitions. Structured education enhances patient self-management capacity, reducing complication risks through protocol adherence.

4.6 Postoperative administration of a combination of drugs and physical therapy

Pain and swelling demonstrate bidirectional exacerbation, with severe pain inducing hypothalamic–pituitary–adrenal (HPA) axis dysregulation that impairs appetite, sleep quality, limb mobilization, and surgical site healing (43). To address exercise-limiting pain and anticipatory anxiety, postoperative NSAIDs are routinely administered. Concurrently, clinicians must educate patients on critical rehabilitation principles: (1) premature repetitive exercise risks wound disruption, whereas exercise avoidance compromises functional recovery; (2) structured cognitive restructuring mitigates kinesiophobia. Implementation requires integrating attention-diversion techniques (e.g., controlled breathing > media engagement) with antalgic positioning to enhance comfort—collectively optimizing rehabilitation adherence while reducing iatrogenic injury risks (44).

Adjunctive modalities further mitigate pain and swelling. Physiotherapy interventions—including ultrashort wave, therapeutic ultrasound, or hyperbaric oxygen applied to peri-incisional tissues starting postoperative day 2—enhance microcirculation, reduce inflammation, and accelerate hematoma resorption. Complementary traditional Chinese medicine (TCM) approaches, such as *Crocus sativus* L. infusion and Shujin Huoxue Lotion, demonstrate pharmacodynamic properties that suppress inflammatory exudation, promote hematoma decompression, and alleviate exercise-induced discomfort during early rehabilitation (3, 45).

5 Conclusion

Both open surgery and endoscope-assisted techniques improve functional satisfaction in gluteal muscle contracture patients. However, arthroscopic release demonstrates superior outcomes: fewer complications, enhanced cosmesis, smaller incisions, and shorter hospitalization. Minimally invasive arthroscopy constitutes the gold standard for gluteal contracture management, with postoperative complications (e.g., surgical site swelling, subcutaneous hematoma) primarily driven by preoperative patient factors, intraoperative technical variances, and postoperative rehabilitation deviations. To optimize outcomes, surgeons must master procedural anatomy, maintain hemorrhage control and irrigation pressure, and implement hemostasis-drainage synergies—while standardized perioperative care bundles encompassing structured preoperative education, intraoperative positioning precision, dynamic pressure monitoring, postoperative compression dressings, and multimodal analgesia collectively reduce complications and hospitalization duration. Technological advancements now position arthroscopy as routine practice, yet establishing systematic surgical-nursing protocols coupled with patient-centric self-management education remains critical for safety and accelerated rehabilitation. Due to the scant literature on intraoperative gluteal perfusion pressure, our analysis could not explore this parameter in depth. Further investigations

should prioritize randomized trials comparing different perfusion pressures during surgery, along with longitudinal studies tracking long-term swelling management outcomes.

Author contributions

YR: Funding acquisition, Writing – original draft. LY: Investigation, Writing – original draft, Conceptualization. YF: Writing – original draft, Methodology. BC: Investigation, Writing – original draft. YT: Writing – original draft, Methodology. SH: Writing – original draft, Conceptualization, Investigation. JL: Writing – review & editing, Visualization, Resources. CY: Validation, Writing – review & editing.

Funding

The author(s) declare that financial support was received for the research and/or publication of this article. This study was supported by Peking University Shenzhen Hospital Research Project (LCYJ2020003), Shenzhen Science and Technology Program (JCYJ20220530160212028), and Shenzhen Health Economics Project (202532).

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Correction note

A correction has been made to this article. Details can be found at: [10.3389/fmed.2025.1716270](https://doi.org/10.3389/fmed.2025.1716270).

Generative AI statement

The authors declare that no Gen AI was used in the creation of this manuscript.

Any alternative text (alt text) provided alongside figures in this article has been generated by Frontiers with the support of artificial intelligence and reasonable efforts have been made to ensure accuracy, including review by the authors wherever possible. If you identify any issues, please contact us.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

References

- J Y, L T, W L, C G, L J. Comparison of open surgery versus endoscopic-assisted release for gluteal muscle contracture: a systematic review and meta-analysis. *J Orthop Surg.* (2024) 19:452. doi: 10.1186/s13018-023-04452-7
- Huang JB, Ge H, Zhang YL, Liu CT, Xue C, Chen YC, et al. The role of arthroscopic release of gluteal muscle contracture in improving patellofemoral instability. *J Orthop Surg Res.* (2019) 14:159. doi: 10.1186/s13018-019-1187-9
- Liu YJ, Wang Y, Xue J, Lui PPY, Chan KM. Arthroscopic gluteal muscle contracture release with radiofrequency energy. *Clin Orthop.* (2009) 467:799–804. doi: 10.1007/s11999-008-0595-7
- Rai S, Meng C, Wang X, Chaudhary N, Jin S, Yang S, et al. Gluteal muscle contracture: diagnosis and management options. *Sicot-J.* (2017) 3:1. doi: 10.1051/sicotj/2016036
- Tang X, Qi W, Liu Y, Xiang Y, Zhang B, Li H, et al. Arthroscopic C-shaped release around the greater trochanter for gluteal muscle contracture. *Orthop Surg.* (2021) 13:1765–72. doi: 10.1111/os.13103
- Jy Y, Hs K, Ks Y, Js C, Pw Y. Arthroscopic treatment for external snapping hip. *Hip Pelvis.* (2014) 26:173. doi: 10.5371/hp.2014.26.3.173
- Jiang X, Zhang H, Ren Y, Yang L, Zhong L, Guo J, et al. The pattern of collagen production may contribute to the gluteal muscle contracture pathogenic process. *J Orthop Surg.* (2023) 18:579. doi: 10.1186/s13018-023-04069-w
- Y Y, Z P, L S, et al. Minimally invasive treatment of grade I and II gluteal muscle contracture using a self-made special cutter combined with a specialized compression hemostasis device. *BMC Musculoskelet Disord.* (2024) 25:1024. doi: 10.1186/s12891-024-08150-1
- Kumar S, Pflueger G. Delayed femoral nerve palsy associated with iliopsoas hematoma after primary total hip arthroplasty. *Case Rep Orthop.* (2016) 2016:6963542. doi: 10.1155/2016/6963542
- Paxinos O, Bountouris I, Grigoropoulos P, Kouris N, Lagios K. Delayed femoral nerve palsy due to femoral artery pseudo-aneurysm after a total hip replacement through an anterolateral approach. *Arthroplast Today.* (2024) 28:101445. doi: 10.1016/j.artd.2024.101445
- Fagotti L, Ejnisman L, Gurgel HDMC, Miyahara HDS, Croci AT, Vicente JRN. Two classifications for surgical wound hematoma after total hip replacement. *Acta Ortop Bras.* (2018) 26:11–5. doi: 10.1590/1413-785220182601175203
- Chen S, Wu Q, Wang Y, Xu J, Wang Y, Luo X. miR-491-5p inhibits Emilin 1 to promote fibroblasts proliferation and fibrosis in gluteal muscle contracture via TGF- β 1/Smad2 pathway. *Physiol Res.* (2022) 71:285–95. doi: 10.33549/physiolres.934804
- Xu H, Yao J, Jin Q, Yao J, Ren L, Zhu J, et al. FKBP10 silencing alleviates gluteal muscle contracture by inhibiting fibrosis and restoring autophagy via HSP47/SMAD3 pathway inactivation. *Am J Pathol.* (2025) 195:1504–22. doi: 10.1016/j.ajpath.2025.04.005
- Li JG, Lin JJ, Wang ZL, Cai WK, Wang PN, Jia Q. Melatonin attenuates inflammation of acute pulpitis subjected to dental pulp injury. *Am J Transl Res.* (2015) 7:66–78.
- Osborn SL, So M, Hambro S, Nolte JA, Kurzrock EA. Inoculation of blood vessels allows early perfusion and vitality of bladder grafts—implications for bioengineered bladder wall. *Tissue Eng Part A.* (2015) 21:1906–15. doi: 10.1089/ten.TEA.2014.0630
- Bragg D, El-Sharkawy AM, Psaltis E, Maxwell-Armstrong CA, Lobo DN. Postoperative ileus: recent developments in pathophysiology and management. *Clin Nutr.* (2015) 34:367–76. doi: 10.1016/j.clnu.2015.01.016
- Fuji T, Akagi M, Abe Y, Oda E, Matsubayashi D, Ota K, et al. Incidence of venous thromboembolism and bleeding events in patients with lower extremity orthopedic surgery: a retrospective analysis of a Japanese healthcare database. *J Orthop Surg.* (2017) 12:55. doi: 10.1186/s13018-017-0549-4
- Shrestha A, Wu P, Ge H, Cheng B. Clinical outcomes of arthroscopic surgery for external snapping hip. *J Orthop Surg Res.* (2017) 12:81. doi: 10.1186/s13018-017-0584-1
- Coutts SB, Menon BK. Late thrombolysis for stroke works, but how do we do it? *Lancet.* (2019) 394:97–8. doi: 10.1016/S0140-6736(19)31095-5
- Wu H. Red blood cell distribution width: a predictor of prognosis in cardiac surgery. *J Card Surg.* (2021) 36:3015. doi: 10.1111/jocs.15612
- Jastrzębski M, Kielbasa G, Moskal P, Bednarek A, Rajzer M, Curila K, et al. Right bundle branch pacing: criteria, characteristics, and outcomes. *Heart Rhythm.* (2023) 20:492–500. doi: 10.1016/j.hrthm.2023.01.017
- Calmon R, Dangouloff-Ros V, Varlet P, Deroulers C, Philippe C, Debily MA, et al. Radiogenomics of diffuse intrinsic pontine gliomas (DIPGs): correlation of histological and biological characteristics with multimodal MRI features. *Eur Radiol.* (2021) 31:8913–24. doi: 10.1007/s00330-021-07991-x
- Sandomirski A, Johanson J, Lohmann C, Lietz J. Total arthroplasty of the ankle joint: limitations and potentials. *Z Rheumatol.* (2023) 82:852–8. doi: 10.1007/s00393-023-01422-6
- Walker-Santiago R, Maldonado DR, Domb BG, Lall AC. Fundamentals of arthroscopy fluid management and strategies to safely improve visualization. *J Am Acad Orthop Surg.* (2021) 29:862–71. doi: 10.5435/JAAOS-D-20-01057
- Unterguggenberger C, Jahangir S, Salzmann GM, Stoddart MJ, Grad S, Schmal H, et al. Response of articular cartilage to hyperosmolar stress: report of an ex vivo injury model. *Am J Sports Med.* (2024) 52:1596–607. doi: 10.1177/03635465241241089
- Chen W, Wang X, Liu J, Wang M, Yang S, Yang L, et al. Association between hypoperfusion intensity ratio and postthrombectomy malignant brain edema for acute ischemic stroke. *Neurocrit Care.* (2024) 40:196–204. doi: 10.1007/s12028-023-01900-4
- Çatal B, Azboy İ. Fluid retention after shoulder arthroscopy: gravity flow vs. automated pump—a prospective randomized study. *J Shoulder Elb Surg.* (2019) 28:1911–7. doi: 10.1016/j.jse.2019.05.041
- Alaei M, Abdulhasan DJK, Barjasteh A, al-Asady AM, Latifi H, Vahedi E, et al. Advancing novel strategies against post-surgical tendon adhesion bands, exploring new frontiers. *Curr Pharm Des.* (2024) 30:1650–8. doi: 10.2174/0113816128299091240423121840
- Gage MJ, Yoon RS, Gaines RJ, Dunbar RP, Egol KA, Liporace FA. Dead space management after orthopaedic trauma: tips, tricks, and pitfalls. *J Orthop Trauma.* (2016) 30:64–70. doi: 10.1097/BOT.0000000000000454
- MacLean J, Wustrack R, Kandemir U. Gluteal compartment syndrome. *Tech Orthop.* (2012) 27:43–6. doi: 10.1097/BTO.0b013e318249a997
- Smith C, Kruger MJ, Smith RM, Myburgh KH. The inflammatory response to skeletal muscle injury: illuminating complexities. *Sports Med.* (2008) 38:947–69. doi: 10.2165/00007256-200838110-00005
- Storgaard Jensen S, Lund K, Lange J. The effect of iliotibial band surgery at the hip: a systematic review. *BMC Musculoskelet Disord.* (2023) 24:75. doi: 10.1186/s12891-023-06169-4
- Li Q, Lingyan Z, Yan L, Yulan P. The role of ultrasonography in the diagnosis of gluteal muscle contracture. *Skeletal Radiol.* (2011) 40:215–21. doi: 10.1007/s00256-009-0869-5
- Alves K, Katz JN, Sabatini CS. Gluteal fibrosis and its surgical treatment. *J Bone Joint Surg Am.* (2019) 101:361–8. doi: 10.2106/JBJS.17.01670
- Gao SG, Liu WJ, Yang M, Li JP, Su C, Kuang SD, et al. Clinical results of arthroscopic tight fibrous band release for adult moderate-to-severe gluteal fibrosis using anterior and posterior portals: a retrospective analysis of 118 consecutive cases. *BMC Musculoskelet Disord.* (2021) 22:28. doi: 10.1186/s12891-020-03885-z
- Dai Z, Chen Z, Liao Y, Tang Z, Cui J. Comparison of arthroscopic versus open surgery on external snapping hip caused by gluteal muscle contracture. *Hip Int J Clin Exp Res Hip Pathol Ther.* (2017) 16:565. doi: 10.5301/hipint.5000565
- Wu YD, Yu KK, An MY, Li ZY, Wang BD, Li YB, et al. Clinical efficacy of the treatment of bilateral gluteal muscle contracture by inside-out iliotibial band release under arthroscopy in the supine position. *Zhonghua Yi Xue Za Zhi.* (2023) 103:1611–6. doi: 10.3760/cma.j.cn112137-20221212-02633
- Kuo CC, Lin CC, Lee WJ, Huang WT. Comparing the antiseptic and analgesic effects of three different ice pack therapy durations: a randomized controlled trial on cases with soft tissue injuries. *J Nurs Res.* (2013) 21:186–94. doi: 10.1097/jnr.0b013e3182a0af12
- Ma J, Huang Z, Huang Q, Zhou Z, Pei F, Shen B. Tranexamic acid combined with compression dressing reduces blood loss in gluteal muscle contracture surgery. *BMC Surg.* (2022) 22:46. doi: 10.1186/s12893-022-01497-z
- Wang J, He S, Shang G, Lv N, Shu X, Zhu Z. Epinephrine injection monotherapy shows similar hemostatic efficacy to epinephrine injection combined therapy in high-risk patients (forrest ib) with bleeding ulcers. *Surg Endosc.* (2023) 37:6954–63. doi: 10.1007/s00464-023-10152-4
- Moseng T, Vliet Vlieland TPM, Battista S, Beckwée D, Boyadzhieva V, Conaghan PG, et al. EULAR recommendations for the non-pharmacological core management of hip and knee osteoarthritis: 2023 update. *Ann Rheum Dis.* (2024) 83:730–40. doi: 10.1136/ard-2023-225041
- Liu GH, Cao FQ, Yang SH, Zhu JF. Factors influencing the treatment of severe gluteal muscle contracture in children. *J Pediatr Orthop B.* (2011) 20:67–9. doi: 10.1097/BPB.0b013e31828341bcb2
- Dai L, Tong R, Cai J, Deng C, Chen Y. The application of continuous care model in rehabilitation management for total hip arthroplasty patients. *Int J Orthop Trauma Nurs.* (2025) 58:101205. doi: 10.1016/j.ijotn.2025.101205
- Luo B, Kong L, Yuan M. An experience of the intervention effect of individualized on the rehabilitation exercise on bone and joint pain symptoms caused by anastomosis. *Asian J Surg.* (2023) 46:2774. doi: 10.1016/j.asjsur.2023.01.036
- Kotsifaki R, Korakakis V, King E, Barbosa O, Maree D, Pantouveris M, et al. Aspetar clinical practice guideline on rehabilitation after anterior cruciate ligament reconstruction. *Br J Sports Med.* (2023) 57:500–14. doi: 10.1136/bjsports-2022-106158