

Genicular Artery Embolization:

A Novel Treatment for Osteoarthritis-Related Knee Pain



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Osteoarthritis (OA) of the knee is a common cause of pain and disability encountered every day in clinical practice, particularly in an aging population. Numerous treatment options exist ranging from non-invasive options such as physical therapy and oral pain medications to steroid injections and knee replacement surgery. These treatments target symptoms or structural issues in the knee.

An often underappreciated contributor to pain is synovial inflammation, which is seen early in the development of OA and has been shown to correlate with pain.¹ As a result of the inflammation, abnormal vascularity develops within the synovium, which drives further inflammation and pain.

Genicular artery embolization (GAE) targets this neovascularity. By selectively occluding the abnormal vessels while preserving the main branches of the genicular arteries, the procedure safely reduces synovial neovascularity and subsequently inflammation and pain.

Minimally Invasive GAE Procedure

GAE is performed under fluoroscopic guidance by an interventional radiologist. A small catheter is inserted via a femoral or pedal artery puncture, and a microcatheter is navigated into the genicular branches supplying the inflamed synovium. Images of the arteries supplying the knee are obtained by injecting contrast, and

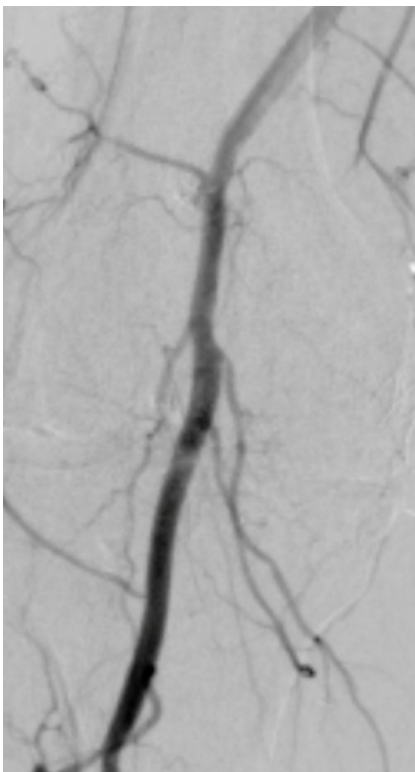


Figure 1: Arteriograms of the right knee before (left) and after (right) selective genicular artery embolization. Following embolization, the hyperemia/neovascularity (red circle) is substantially decreased in both the medial and lateral tibiofemoral compartments.

the abnormal vessels are selectively embolized (Figure 1). Embolization is performed using permanent microsphere particles or temporary embolics such as imipenem-cilastatin or lipiodol.^{2,3} The procedure is performed on an outpatient basis under light sedation and typically takes about an hour. Patients can expect to return to normal activity the following day.

Safety, Efficacy, and Durability of GAE

Current evidence supports GAE as a safe and effective treatment for refractory knee pain. In multiple multicenter trials, sham studies, and meta-analyses, statistically significant improvements in pain, as measured by the visual

analog scale (VAS), and pain/function, as measured by the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), have been demonstrated. Pooled data shows a 54% improvement in VAS at 1 week and 80% improvement at 2 years, with WOMAC improving by 58% and 85%, respectively. GAE resulted in a decreased need for pain medication for knee OA, with a 27%, 65%, and 73% decline in the number of patients who used opioids, nonsteroidal anti-inflammatory drugs, and intra-articular hyaluronic acid injections.^{4,5} For patients responding to treatment, the results have been durable for at least 2 years in clinical trials, a significant benefit compared to other minimally invasive treatments, such as steroid injections that are effective for months, not years.^{6,7} Clinical trial patients who subsequently underwent knee replacement did not experience complications or unexpected difficulties related to prior embolization. Thus far, no severe or life-threatening complications have been reported in the literature. The most common complication is self-limited, transient skin color change, followed by much less common minor complications such as puncture site hematomas.

Patients Who Are Candidates for GAE

Patients with moderate to severe OA-related knee pain not well controlled by conservative measures, poor surgical candidates for knee replacement, or those who have declined surgery can be considered for GAE. Contraindications would include active infection, irreversible coagulopathy, and significant peripheral vascular disease. Several multicenter trials are underway to further delineate its long-term efficacy, ideal patient profile, optimal embolic choice, and cost-effectiveness. Consensus guidelines and standardized protocols will likely follow in the coming years.

Conclusion

Genicular artery embolization is a safe and effective minimally invasive treatment option for knee pain due to osteoarthritis in well-selected patients. It serves as a valuable adjunct to existing standard treatments such as anti-inflammatory medications, physical therapy, joint injections, and knee replacement. As part of a multidisciplinary strategy, it can improve quality of life, reduce pain medication use, delay the need for surgery, or serve as a bridge to future treatments. Patients with inadequate relief from more conservative measures who are not ready or not candidates for knee replacement are best served by the procedure.

References

- Sanchez-Lopez E, Coras R, Torres A, Lane NE, Guma M. Synovial inflammation in osteoarthritis progression. *Nat Rev Rheumatol*. Springer Science and Business Media LLC; 2022;18(5):258–275. doi: 10.1038/s41584-022-00749-9.
- Sapoval M, Querub C, Pereira H, et al. Genicular artery embolization for knee osteoarthritis: Results of the Lipio-Joint-1 trial. *Diagn Interv Imaging*. Diagn Interv Imaging; 2024;105(4):144–150. doi: 10.1016/j.diii.2023.12.003.
- Correa MP, Motta-Leal-Filho JM, Lugokeski R, Mezzomo M, Leite LR. GAUCHO - trial genicular artery embolization using imipenem/cilastatin vs. Microsphere for knee osteoarthritis: A randomized controlled trial. *Cardiovasc Radiol*. Springer Science and Business Media LLC; 2022;45(7):903–910. doi: 10.1007/s00270-022-03089-z.
- Epelboym Y, Mandell JC, Collins JE, et al. Genicular artery embolization as a treatment for osteoarthritis related knee pain: A systematic review and meta-analysis. *Cardiovasc Radiol*. Cardiovasc Intervent Radiol; 2023;46(6):760–769. doi: 10.1007/s00270-023-03422-0.
- Torkian P, Golzarian J, Chalian M, et al. Osteoarthritis-related knee pain treated with genicular artery embolization: A systematic review and meta-analysis. *Orthop J Sports Med*. SAGE Publications; 2021;9(7):23259671211021356. doi: 10.1177/23259671211021356.
- Little MW, O’Grady A, Briggs J, et al. Genicular artery embolisation in patients with osteoarthritis of the knee (GENESIS) using permanent microspheres: Long-term results. *Cardiovasc Radiol*. Springer Science and Business Media LLC; 2024;47(12):1750–1762. doi: 10.1007/s00270-024-03752-7.
- Okuno Y, Korch AM, Shinjo T, Kato S, Kaneko T. Midterm clinical outcomes and MR imaging changes after transcatheter arterial embolization as a treatment for mild to moderate radiographic knee osteoarthritis resistant to conservative treatment. *J Vasc Interv Radiol*. J Vasc Interv Radiol; 2017;28(7):995–1002. doi: 10.1016/j.jvir.2017.02.033.