

Efficacy of Genicular Artery Embolization in Treatment of Knee Osteoarthritis Related Pain

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ABSTRACT

Background:

Knee osteoarthritis (OA) is a prevalent degenerative joint disorder that significantly impairs quality of life through chronic pain, stiffness, and functional limitation. Traditional management follows a stepwise approach beginning with conservative therapies and progressing to surgical intervention in advanced cases. In recent years, genicular artery embolization (GAE) has emerged as a promising minimally invasive option targeting synovial hypervascularity, a recognized contributor to inflammation and pain in OA.

Results:

The study included patients with a mean age of 57.6 years, with a slight female predominance (56.7%). The pre-operative mean WOMAC score was 56.8. while post-operative the mean score was 37.80 at 3 months and was 32.03 at 6 months, also Pre-operatively, all patients required analgesics either oral (60%) or combined oral and injection (40%) while post-operative, 60% of patients requiring no pain medications.

Conclusion:

GAE is minimally invasive procedure that showing effective and durable reduction in pain symptoms from knee OA that is refractory to other conservative therapy with significant reduction of WOMAC score and pain medication usage together with minor complications reported.

Keywords: Knee osteoarthritis, Genicular artery embolization and WOMAC score

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BACKGROUND:

- ❑ Knee osteoarthritis is the most common type of arthritis diagnosed, and its prevalence will continue to increase as life expectancy and obesity rises, roughly 13% of women and 10% of men aged 60 years and older have symptomatic knee osteoarthritis and the prevalence rises to about 40% in people older than 70 years ⁽¹⁾
- ❑ The diagnosis of knee osteoarthritis will begin with a physical examination followed by some radiological studies including Plain X-ray and Computed Tomography that shows narrowing of joint spaces, marginal cortical sclerosis and osteophytes formation, also Magnetic Resonance Imaging has a great role to determine the meniscal damage together with abnormalities in tendons and ligaments. Blood tests are required to rule out some secondary causes of knee osteoarthritis like rheumatoid arthritis and infections ⁽²⁾
- ❑ Treatment for knee osteoarthritis depends on the cause and usually combination of conservative methods like weight loss, exercise and some physical therapy, some medications as Pain relievers and anti-inflammatory drugs, some interventional radiological procedures with the final option being the surgery like osteotomy and arthroplasty ^(3, 4)
- ❑ Interventional radiology plays a recent role in relieve the pain of knee osteoarthritis especially in patients who are unfit for surgery or refused to do surgery and also to the patients with side effects related to medications or unsuitable to take some medications ⁽⁵⁾

- ❑ There are different interventional radiological procedures as palliative treatment for knee osteoarthritis like corticosteroid or hyaluronic acid injection into the knee, radiofrequency ablation of genicular nerves and embolization of genicular artery.
- ❑ Genicular artery embolization is one of the recent minimally invasive procedures that used in the last few years to relieve the pain of knee osteoarthritis, this procedure targets pathological hypervascularity within affected periarticular regions by selectively reducing abnormal high arterial inflow, This attenuation of hyperemia leads to subsequent decrease in inflammatory cytokines and biochemical mediators implicated in the pathogenesis of osteoarthritis. By down-regulating these inflammatory pathways, GAE contributes to suppression of chronic synovitis and ultimately results in clinically significant pain reduction ^(6,7)
- ❑ This study was conducted to evaluate the role of genicular artery embolization as a minimally-invasive technique in relieve of pain secondary to knee osteoarthritis and so decrease the patient medications for relieve of pain and protect the patient from these medications side effects especially on the stomach and the kidney, also postpone the arthroscopy operation if needed to more longer time.

METHODS

Study design and population

- ❑ This prospective study was carried on 30 patients who have symptoms of knee osteoarthritis from the period of June 2022 to June 2024, the patients were examined by X-ray study and some patients were examined by conventional MRI study.
- ❑ Ethics committee approved, and informed consent were obtained for all patients or their guardians with full explanation of the procedure, risks and purpose of the procedure. Privacy and confidentiality of all patients' data were guaranteed, all data provision were monitored and used for security purpose only.

Inclusion criteria

- 1- Patients with knee osteoarthritis who are
 - Contraindicated to perform surgery.
 - Refuse to do surgery.
 - Have side effects of knee osteoarthritis related medication.
 - Have pain refractory to conservative therapy.
- 2- Patients with post arthroplasty recurrent pain.

Exclusion criteria

- 1- Pregnant patients
- 2- Patients who have advanced atherosclerosis
- 3- Patients with known history of hypersensitivity to contrast media
- 4- Patients with renal impairment

All patients were subjected to the following:

- 1- Full history taking.
- 2- Clinical examination.
- 3- Categorization according to severity of osteoarthritis into mild, moderate and marked osteoarthritis based on imaging mainly Radiography.
- 4- Evaluation by the body mass index.
- 5- Pain, stiffness and disability were assessed with the Western Ontario and McMaster Universities Osteoarthritis index (WOMAC) questionnaire before the procedure and at 3 and 6 months after the procedure.

PREPARATION AND TECHNIQUE

Before the procedure

- Renal function and blood clotting tests were assessed together with evaluation of any predicted contrast allergy of some patients
- Stop any anticoagulant 24 hours before the procedure
- Fasting 6 hours before the procedure

Technique

- 1- Local anesthesia at the arterial puncture site.
- 2- Arterial access was done to ipsilateral femoral artery with a 6-Fr sheath.
- 3- Lower extremity subtraction angiography was performed of the distal superficial femoral artery to identify the target genicular arteries in the region of maximal pain.
- 4- A 2.4 Fr microcatheter was used to catheterize the genicular arteries and angiography was performed to identify a synovial blush pattern of opacity (Arrows)
- 5- Embolization was performed with either 75 µm (five patients) or 100 µm (25 patients) spherical particles

- 6- To create a dilute embolic solution, 9 ml of contrast material was added to 6 ml of particles in solution that presented in the pre packaged syringe.
- 7- The embolization technique involved injecting small amount of embolic solution followed by digital subtraction angiography after each injection. This was continued until the “tumor blush pattern” would no longer be evident
- 8- The procedure was considered successful if just one or two of the genicular arteries supplying the region of maximal tenderness are embolized and no tumor blush could be seen on angiography.
- 9- Patients were discharged on the same day. Assessment for adverse events was performed at 1 day after the procedure and at all follow-up intervals.

STATISTICAL ANALYSIS:

- ❑ Statistical analysis of the present study was conducted by SPSS V.20. Qualitative data was presented using number and percentage. Quantative data presented as mean and standard deviation (SD).
- ❑ For categorical variables, Sig test and Chi-square tests were used for analysis. The level of significance was adopted at $p < 0.05$.

RESULTS

- This study was carried on 30 patients with mean age for the patients was 57.63 ± 6.67 years old. Males represented 43.3%, while females represented 56.7%.
- WOMAC score was assessed before the procedure and at 3 and 6 months after the procedure with few parameters were taken into consideration during this study as workload of the patients, Body mass index, pain medication, medical history, grading of osteoarthritis and number of embolized arteries
- The Pre-operative total WOMAC score had a mean score of 56.8 classified as mean score of 12.4 for pain subscale, 4.4 for stiffness subscale and 40.4 for the physical function subscale
- The mean of the WOMAC score was 56.8 pre-operatively, which significantly decreased to 37.80 at 3 months and further to 32.03 at 6 months ($P = 0.001^*$). These results indicate a significant improvement in WOMAC scores over time following the procedure (**Table 1**)

Table (1): WOMAC score follow up.

	WOMAC			P
	Pre-operative	At 3 months	At 6 months	
mean $\pm$ s.d	56.8 $\pm$ 15.1	37.80 $\pm$ 15.12	32.03 $\pm$ 15.43	0.001*
Range	32.0 - 88.0	20.00 - 78.00	10.00 - 75.00	

Regarding body mass index

Only one patient (3.3%) had normal BMI, 17 patients (56.7%) had overweight, 8 patients (26.7%) had obesity grade I and 4 patients (13.3%) had Obesity grade II,

- ❑ The results at 3 and 6 months after the procedure are closely similar with a trend toward significance ($P = 0.061$), with normal BMI patients scoring 26.0 ± 0.0 , overweight patients 32.9 ± 14.9 , obesity (grade I) 42.0 ± 14.1 , and obesity (grade II) 53.0 ± 5.9 (**Tables 2 and 3**)

Regarding pain medication

Before the procedure, all the patients used medications with 60 % ($n = 18$) were using one type of oral medication, and 40 % ($n = 12$) were using two types (oral and injections).

- ❑ Post-operatively, the rate of patients not requiring medications increased significantly to 60% ($n = 18$), while those using one type of oral medication decreased to 36.6% ($n = 11$), and those using two types dropped to 3.3% ($n = 1$). The change in medication usage was statistically significant ($P=0.0001^*$) (**Tables 2 and 3**)

Regarding grading of osteoarthritis

Grading of osteoarthritis was based on X-ray study with Kellgren-Lawrence classification and showed that 9 patients (30.0%) had Mild osteoarthritis, 15 patients (50.0%) had moderate osteoarthritis and 6 patients (20%) had marked osteoarthritis

- ❑ The grading of osteoarthritis at 3 and 6 months after the procedure, significantly affected prognosis ($P = 0.001^*$), with mild cases scoring 23.1 ± 3.9 , moderate cases 37.3 ± 8.0 , and marked cases 61.2 ± 8.9 (**Tables 2 and 3**)

Table (2): Factors affecting WOMAC score at 3 months.

	Post-operative WOMAC score at 3 months			Sig test	P
	Mean	±	S.d		
<u>Gender</u>					
Male	39.8	±	16.6	0.381	0.542
Female	36.3	±	14.2		
<u>BMI</u>					
Normal	26.0	±	0.0	2.771	0.061
Overweight	32.9	±	14.9		
Obesity grade I	42.0	±	14.1		
Obesity grade II	53.0	±	5.9		
<u>Grading of osteoarthritis</u>					
Mild	23.1	±	3.9	50.118	0.001*
Moderate	37.3	±	8.0		
Marked	61.2	±	8.9		

Table (3): Factors affecting WOMAC score at 6 months.

	Post-operative WOMAC score at 6 months			Sig test	P
	Mean	±	S.d		
<u>Gender</u>					
Male	34.1	±	16.5	0.781	0.468
Female	30.5	±	14.9		
<u>BMI</u>					
Normal	20.0	±	.	1.427	0.257
Overweight	28.3	±	15.5		
Obesity grade I	36.1	±	16.7		
Obesity grade II	42.8	±	7.1		
<u>Grading of osteoarthritis</u>					
Mild	18.8	±	5.2	32.298	0.001*
Moderate	30.7	±	8.5		
Marked	55.3	±	12.7		

This male patient aged 66 years old presented by persistent knee pain with difficulty in walking and no satisfying response on medical treatment, Pre-operative imaging shows moderate knee osteoarthritis with pre-operative WOMAC score = 62 while post-operative WOMAC score at 6 months = 33

(A) Pre-embolization selective catheterization and digital subtraction angiogram of the superior medial genicular artery confirms the presence of significant synovial blush.

(B) Post-embolization angiogram shows near total loss of synovial blush.

This female patient aged 67 years old presented by significant knee pain disrupting him from normal daily activity, Pre-operative imaging shows moderate knee osteoarthritis with pre-operative WOMAC score = 80 while post operative WOMAC score at 6 months = 58

(A) Image shows pre-embolization selective catheterization and angiogram of the inferior medial genicular artery with large patchy irregular shaped area of hyperemia and synovial blush

(B) Image shows post-embolization angiogram demonstrating near total loss of synovial blush.

This female patient aged 59 years old presented by significant medial aspect knee pain not adequately respond to medical treatment nor physical therapy, Pre-operative imaging shows mild knee osteoarthritis with WOMAC score = 61 while post operative WOMAC score at 6 months = 32

(A) Image shows pre-embolization selective catheterization and angiogram of the superior medial genicular artery demonstrating the presence of synovial blush at the medial femoral condyle region.

(B) Image shows post-embolization angiogram with significant loss of synovial blush.

Discussion

In the present study, GAE demonstrated meaningful clinical improvement, reflected by a significant reduction in WOMAC scores at 3 and 6 months, reduced analgesic requirements, and improvement in functional status. These findings are consistent with previously published prospective and retrospective studies reporting sustained pain relief and functional improvement following GAE. Okuno et al. first described the association between abnormal synovial neovascularization and OA-related pain, demonstrating that selective embolization results in significant symptom improvement without major complications. Subsequent studies by Bagla et al. and Piechowiak et al. confirmed these outcomes, reporting statistically and clinically significant WOMAC score reductions at mid-term follow-up^(7,8)

The demographic profile of our cohort aligns with prior literature. The predominance of female patients and a mean age in the late fifties reflect the known epidemiology of knee OA, which disproportionately affects women and older adults. Similar age and sex distributions have been reported in GAE cohorts by Sun et al. and Padia et al., reinforcing the external validity of our findings^(9,10)

Regarding OA severity, the majority of patients in this study had mild to moderate disease, a subgroup consistently shown to derive the greatest benefit from GAE. Studies by Little et al. and Liu et al. suggest that while GAE can be effective across a spectrum of disease severity, outcomes tend to be more favorable in earlier stages, likely due to preserved joint architecture and reversible inflammatory changes. Nevertheless, selected patients with advanced OA may still benefit symptomatically, particularly when surgical options are contraindicated or declined^(11,12)

Body mass index (BMI) distribution in our study reflects the well-established association between obesity and knee OA. The predominance of overweight and obese patients mirrors findings from Okuno et al., Little et al., and Sajan et al., highlighting GAE's applicability in this high-risk population. Importantly, elevated BMI did not preclude clinical improvement, supporting GAE as a viable option for patients who may be suboptimal surgical candidates⁽¹³⁾

A notable clinical benefit observed in this study was the substantial reduction in post-procedural analgesic use, an outcome of growing importance given the risks

associated with long-term NSAID and opioid therapy. Similar reductions have been reported by Taslakian et al. and Heller et al., underscoring GAE's potential role in minimizing medication-related morbidity^(14,15)

From a technical standpoint, the predominance of the ipsilateral femoral approach and selective embolization of hypervascular genicular branches aligns with standard practice. Complications were minor and self-limited, including puncture-site hematoma, transient skin changes, and temporary paresthesia, consistent with prior safety reports describing GAE as a low-risk procedure when performed with superselective technique and appropriate particle sizing⁽¹⁶⁾

Limitations

This study has several limitations, including a relatively small sample size, short-term follow-up, and lack of a control group. Additionally, the small number of patients with severe OA limits subgroup analysis. Larger randomized controlled trials with longer follow-up are needed to better define durability, optimal patient selection, and comparative effectiveness against other minimally invasive treatments.

Clinical Implications

Despite these limitations, the findings support GAE as a safe and effective minimally invasive treatment for symptomatic knee OA, particularly in patients with mild-to-moderate disease who have failed conservative therapy and seek alternatives to surgery. Incorporating occupational workload and OA subtype into future studies may further refine patient selection and optimize outcomes.

REFERENCES

- (1) Heidari B. Knee osteoarthritis prevalence, risk factors, pathogenesis and features: Part I. Caspian J Intern Med. 2011 Spring;2(2):205-512
- (2) Price LL, Harkey MS, Ward RJ, et al. Role of magnetic resonance imaging in classifying individuals who will develop accelerated radiographic knee osteoarthritis. Journal of Orthopaedic Research. 2019 Nov;37(11):2420-2028.
- (3) Abdel-Aziz MA, Ahmed H, El-Nekeety AA, et al. Osteoarthritis complications and the recent therapeutic approaches. Inflammopharmacology. 2021 Dec;29(6):1653-1667.
- (4) Filippidis D, Charalampopoulos G, Mazioti A, et al. Interventional radiology techniques for pain

reduction and mobility improvement in patients with knee osteoarthritis. *Diagnostic and Interventional Imaging*. 2019 Jul-Aug;100(7-8):391-400.

(5) Casadaban LC, Mandell JC and Epelboym Y. Genicular artery embolization for osteoarthritis related knee pain: a systematic review and 14 qualitative analysis of clinical outcomes. *CardioVascular and Interventional Radiology*. 2021 Jan;44(1):1-9.

(6) Lauko K, Tangchaiburana S and Padia SA. Transarterial genicular artery embolization as treatment of painful knee osteoarthritis in a 64-year-old woman. *Journal of Radiology Nursing*. 2020 Jun 1;39(2):89-91.

(7) Okuno Y, Korchi AM, Shinjo T, et al. Transcatheter arterial embolization as a treatment for medial knee pain in patients with mild to moderate osteoarthritis. *Cardiovascular and interventional radiology*. 2015 Apr;38:336-3343..

(8) Bagla S, Piechowiak R, Hartman T, et al. Genicular artery embolization for the treatment of knee pain secondary to osteoarthritis. *Journal of Vascular and Interventional Radiology*. 2020 Jul 1;31(7):1096-1102.

(9) Sun CH, Hwang JH, Kim JS, et al. Genicular artery embolization for the treatment of knee osteoarthritis: A single-center prospective study. *Journal of Vascular and Interventional Radiology*. 2022;33 (5):567-575.

(10) Padia SA, Genshaft S, Blumstein G, et al. Genicular artery embolization for the treatment of symptomatic knee osteoarthritis. *JBJS Open Access*. 2021;6 (3):e21.

(11) 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. *CardioVascular and Interventional Radiology*. 2024 May 31:1-13.

(12) Liu S and Badii M. Genicular artery embolization: A review of essential anatomic considerations. *J Vasc Interv Radiol*. 2023;34(9):1419–1425.

(13) Okuno Y, Iwamoto W, Matsumura N, et al. Clinical outcomes of transcatheter arterial embolization for mild to moderate knee osteoarthritis: A prospective study. *J Vasc Interv Radiol*. 2017;28 (7): 995–1002.

(14) Taslakian B, Swilling D, Attur M, et al. Genicular artery embolization for treatment of knee osteoarthritis: interim analysis of a prospective pilot trial including effect on serum osteoarthritis-associated biomarkers. *Journal of Vascular and Interventional Radiology*. 2023 Dec 1;34(12):2180-2189.

(15) Heller DB, Beggin AE, Lam AH, et al. Geniculate artery embolization: role in knee

hemarthrosis and osteoarthritis. *Radiographics*. 2022 Jan;42 (1):289-301.

(16) Taslakian B, Miller LE, Mabud TS, et al. Genicular artery embolization for treatment of knee osteoarthritis pain: Systematic review and meta-analysis. *Osteoarthritis Cartilage Open*. 2023;5(2):100342.