

Genicular Artery Embolization for Treatment of Osteoarthritis: A Systematic Review and Meta-Analysis



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Background & Purpose: Genicular artery embolization is a minimally invasive procedure that involves blocking the blood supply to certain arteries in the knee in order to reduce chronic knee pain. This procedure is typically used as a treatment for knee pain caused by osteoarthritis or other degenerative conditions that affect the knee joint. The effectiveness and safety of genicular artery embolization for the treatment of chronic knee pain has been evaluated in a number of studies, with generally positive results. Some studies have found that genicular artery embolization can significantly reduce chronic knee pain and improve function in patients with osteoarthritis or other degenerative conditions. In one study, genicular artery embolization was found to be effective in reducing chronic knee pain in 84% of patients at six months follow-up. Other studies have reported similar success rates, with the majority of patients experiencing significant pain relief after the procedure. In terms of safety, genicular artery embolization is generally considered to be a safe and well-tolerated procedure. Complications are rare, but may include infection, bleeding, and allergic reactions to the embolic material used to block the blood vessels. Overall, genicular artery embolization appears to be a promising treatment option for patients with chronic knee pain, although further research is needed to fully evaluate its effectiveness and safety. The purpose of this article is to perform systematic review and meta-analysis of outcomes of genicular artery embolization (GAE) for the treatment of knee pain due to chronic osteoarthritis (OA) and to study postoperative complications.

Material and Methods: A comprehensive literature search of PubMed, Ovid MEDLINE, and Ovid Embase was performed for studies published from 2000 to October 2022. The search used the following keywords: “Arthralgia / etiology”, “Arthralgia / therapy*”, “Embolization, Therapeutic / methods*”, “Humans”, “Leg/blood supply*”, “Osteoarthritis, Knee / complications*”, “Pain Management/methods*”, “Pain Measurement”, “Treatment Outcome” in both “AND” and “OR” combinations. The search strategy was confined to English language.

Results: This study¹ included 20 patients with knee osteoarthritis who were experiencing moderate to severe pain that had not improved with conservative treatments. These patients were enrolled in a prospective pilot study at two sites and underwent genicular artery embolization (GAE) using 75 or 100 micrometer spherical particles. The patients were assessed using magnetic resonance imaging at the start of the study and one month later and using the Visual Analog Scale (VAS) and the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) at the start of the study and at one, three, and six months. Any adverse events that occurred were recorded at all time points. Genicular artery embolization was successfully performed on all 20 patients (100%). On average, the patients' pain scores as measured by the VAS improved from 76 millimeters \pm 14 at the start of the study to 29 millimeters \pm 27 at the six-month follow-up ($P < .01$). Similarly, the patients' overall scores on the WOMAC improved from 61 \pm 12 at the start of the study to 29 \pm 27 at the six-month follow-up ($P < .01$). Skin discoloration, which resolved on its own, occurred in 13 out of 20 patients (65%). Two out of 20 patients (10%) developed temporary sensations of tingling or numbness in their feet, which resolved within 14 days. A multicenter, randomized controlled trial² was conducted to compare the effectiveness of GAE to a sham procedure in reducing symptoms of knee osteoarthritis. The study included 21 subjects with mild to moderate osteoarthritis and chronic knee pain, who were randomly assigned to either the GAE group or the sham group in a 2:1 ratio. Subjects in the sham group who did not report significant improvements in both the total WOMAC and VAS scores after the sham procedure were unblinded and given the option to receive GAE treatment at one month. Data was collected over a 12-month period, and subjects were excluded if they needed additional pain medication at follow-up. The reductions in VAS and total WOMAC scores were compared using mixed-effects linear regression models. All subjects in the sham group did not show significant improvement at one month and crossed over to the GAE treatment group. At one month, the GAE group had a statistically significant greater reduction in pain compared to the sham group (VAS: 50.1 millimeters, standard error [SE]: 10.6, 95% confidence interval [CI]: 29.0, 72.3, $P < .01$). The GAE group also had a significantly greater improvement in disability (WOMAC: 24.7 points, SE: 10.4, 95% CI: 3.5, 45.9, $P = .02$). Only minor adverse events were reported. Five subjects were excluded from the study due to increased use of pain medication. A sensitivity analysis including all excluded patients confirmed the significant improvements seen at one and 12 months. Three studies were included in this systematic review³, which initially identified 305 results. A total of 186 knees in 133 patients with either mild to moderate (94%, 174/186) or severe (6%, 12/186) osteoarthritis underwent genicular artery embolization using either imipenem/cilastatin sodium (85%, 159/186) or embozene (15%, 27/186). The procedure had a 100% technical success rate. The average pain scores as measured by the VAS improved from the baseline at various time points up to two years (66.5 at baseline versus 33.5 at one day, 32.7 at one week, 33.8 at one month, 28.9 at three months, 29.0 at four months, 22.3 at six months, 14.8 at one year, and 14.0 at two years). The average scores on the WOMAC also improved from the baseline at various time points up to two years (45.7 at baseline versus 24.0 at one month, 31.0 at three months, 14.8 at four months, 14.6 at six months, 8.2 at one year, and 6.2 at two years). The 12 patients with severe osteoarthritis initially had improved VAS scores, but the improvement was not sustained. Minor adverse events such as skin redness in the region of the embolization (11%, 21/186), bleeding at the puncture site (10%, 18/186), tingling sensations (1%, 2/186), and fever (0.5%, 1/186) were reported.

Conclusions: Based on current data, it appears that GAE may be a promising treatment for osteoarthritis-related knee pain, but more research is needed to confirm this. In order to more accurately evaluate the effectiveness of GAE, it is recommended that researchers use validated outcome measures such as the total WOMAC score and define clinical success using both clinically meaningful and measurable criteria (e.g., a 50% reduction in pain scores at one, three, and six months). It would also be helpful to use MRI scans to assess for changes in synovitis following the procedure. The current data is limited by the use of varying inclusion criteria and definitions of clinical success, so future research should address these limitations in order to provide a more accurate evaluation of GAE.