Case Series Analysis of Trans-Arterial Embolization for Osteoarthritis-Related Hand Pain

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Swiss Journal of Radiology and Nuclear Medicine - www.sjoranm.com
SJORANM GmbH - CH-6340 Baar - Switzerland

Abstract

Osteoarthritis (OA) is a widespread disorder which commonly impacts a significant portion of the population. Although most cases involve the knee joint, it can also affect the carpometacarpal joint and cause significant pain in the hand and thumb. Traditional treatments often provide short-term pain relief and need continual treatment prompting the need for exploring alternative therapies to prolong the duration of pain relief. This case series assesses the clinical success of trans-arterial embolization (TAE) of the joints in the hand as a minimally invasive treatment for chronic pain associated with hand joint OA, defined as a 50% (or greater) decrease in Visual Analog Scale (VAS) score overall, as well as a decrease in prescribed pain medication use. We present a case report of four patients who underwent this intervention for hand joint osteoarthritis. Preliminary results show an average decrease in VAS exceeding the 50% threshold, with a notable reduction in pain medication usage and improvements in daily activities. These findings suggest that TAE shows promise as a minimally invasive therapy for hand joint OA, warranting further investigation into its long-term efficacy and safety.

Keywords: *blush, joint, osteoarthritis, carpometacarpal, embolic, antegrade, VAS.*

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Introduction

Osteoarthritis (OA) is a leading cause of joint pain and chronic disability, significantly impacting the ability to perform activities of daily living (ADLs) (1). Hand joint OA, in particular, can severely limit daily life. While thumb overuse and increased life expectancy are associated with higher prevalence of OA involving the hand, inflammation has been found to be the primary link to its etiology (2). While traditional treatments like pain medications, physical therapy, occupational therapy, and steroid injections often provide temporary relief, interventions such as joint arthroplasty can provide permanent relief (1). However, these surgical interventions carry significant risks such as infection, incisional tenderness, nerve irritation, limitation of mobility, etc., so they may not be suitable for all patients (3,4). As such, trans-arterial embolization (TAE) has emerged as a promising minimally invasive alternative for joint pain (5).

TAE is performed by an endovascular specialist who infuses an embolic agent through a catheter to block targeted blood vessels, interrupting the blood supply that causes inflammation (6). Selective angiography is performed on these arteries, revealing inflamed abnormal vessels that appear as a tumor blush-type enhancement in the arterial phase, often accompanied by early venous drainage. After the abnormal vessels are identified, embolic agents are injected (7). The success of this procedure depends on attenuating this inflammatory blush and avoid embolizing non-target blood vessels to provide long-term pain relief (8).

The objective of this case series is to determine if this intervention for chronic pain as a result of

Table 1: Artery Embolization Case Report

Case	Age	Sex	Diagnosis	Embolic Volume (mL)	Embolic Particle Size (µm)	Initial VAS Score	Post Embolization (1–6 month f/u)
Case 1	78	Female	Left Thumb CMC OA	0.2	100-300	10	VAS 0, decreased intake of pain medications
Case 2	78	Male	Left Thumb CMC OA	0.2	125-275	8	VAS 2, decreased intake of pain medications
Case 3	63	Female	Right Thumb CMC OA	0.5	100-300	10	VAS 1, decreased intake of pain medications
Case 4	58	Female	Right Thumb CMC OA	0.1	100-300	5	VAS 0, does not need pain medication

mL, milliliter; µm, micrometers; CMC, Carpometacarpal; OA, Osteoarthritis; VAS, Visual Analog Score; DIP, distal interphalangeal

osteoarthritis can be deemed clinically successful. In this study, pain is measured through the Visual Analog Scale (VAS), a 0-10 scale for patients to describe the level of pain they feel (9). Clinical success is defined as a 50% (or greater) overall decrease from baseline (pre- embolization) VAS score, measured during follow- up clinical visits, as well as a decrease in dosage and/or frequency of pain medication use, including anti-inflammatories and opioids.

Here, we report on four patients with hand joint osteoarthritis, detailing their arterial embolization intervention outcomes (Tab.1).

Case Report 1

A 78-year-old white female lives independently and is self-sufficient. For the past few years, she had suffered from progressive pain corresponding to osteoarthritis in both carpometacarpal (CMC) joints. She had reported increased pain in her left hand to the point of interference with daily activities and reports a VAS score of 10. Patient presented with variable grip strength due to pain with flexion of her CMC joint, causing her to frequently drop objects. Patient had tried intra-articular steroids as well as pain medications and braces, but with no reduction in her symptoms. Given that she lives independently, she wanted to exhaust all non- invasive options before pursuing a surgical intervention. Using ultrasound for guidance, the left radial artery was identified, and the overlying skin was infiltrated with lidocaine. Access into the left radial artery was then obtained in an antegrade fashion with the dilator of a pedal access 2.9 French micro puncture kit (Cook) followed by selective left radial angiography. Next, 50 mcg of intra-arterial nitroglycerin followed by a saline flush was administered into the left radial artery. Angiography via the dilator demonstrated significant inflammatory blush. Then, 0.2mL of 100 to 300 µm Embospheres (Merit Medical) were injected into the artery very slowly with subsequent abolition of all blush. (Fig.1) There were no distal embolic complications that followed. Manual pressure was applied to obtain hemostasis. Two weeks post embolic intervention patient reported significant improvement in her thumb pain, reporting her VAS score of 6. Four weeks post embolic intervention, the patient reported a VAS score of 3. At four months post intervention, the patient reported VAS score of 0, no pain, and a complete return to performing her ADLs unimpeded. Patient was able to completely stop her pain medications after TAE.

Case Report 2

An independent 78-year-old Pakistani male presented with a longstanding history of left CMC joint osteoarthritis. Patient reported persistent pain for at least six years with repeated steroid injections, multiple attempts with braces and physical therapy and a baseline VAS score of 8. He was offered surgery but did not want to pursue invasive surgical options since he lives independently.

Using ultrasound for guidance, the left radial artery was identified, and the overlying skin was infiltrated with lidocaine. Access into the left radial artery was then obtained in an antegrade fashion with the dilator of a pedal access 2.9 French micro puncture kit (Cook) followed by selective left radial angiography. After 100 mcg of intra-arterial nitroglycerin and saline flush, angio-

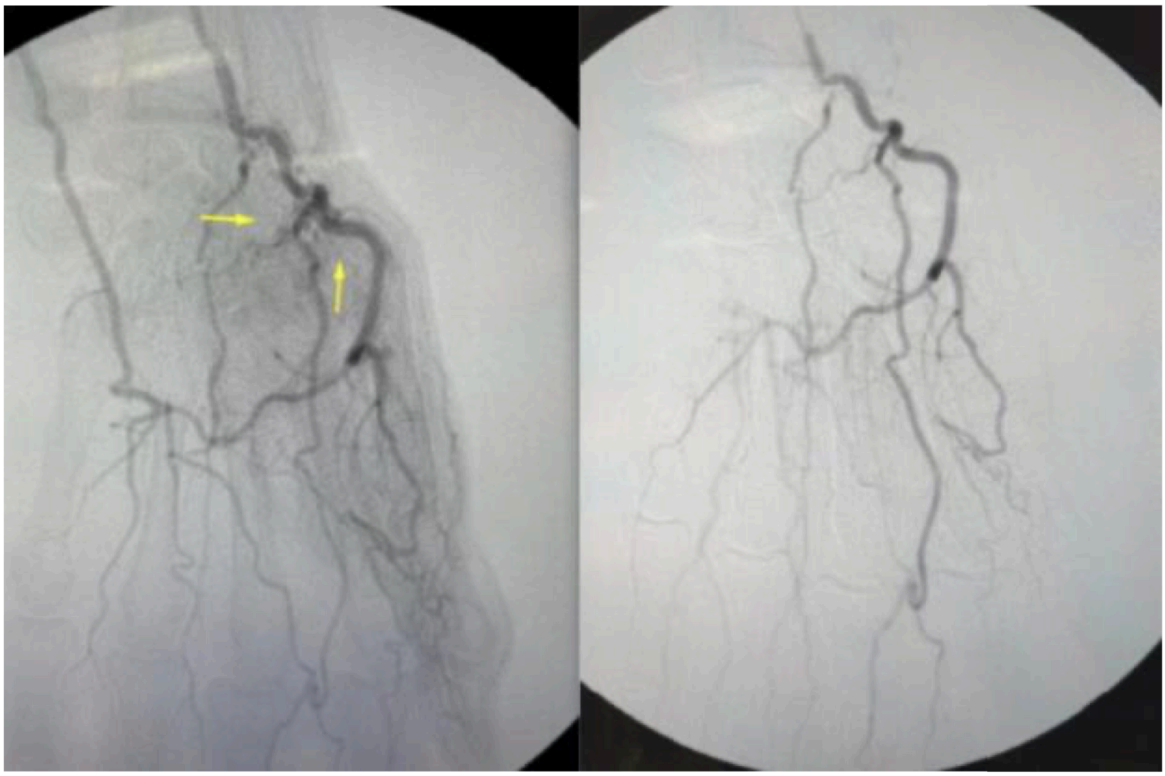

Figure 1: Case 1. [Left] Angiogram of the left CMC joint pre-embolic intervention. [Right] Angiogram of the left CMC joint post-embolic intervention.

graphy revealed significant blush at the level of the left CMC joint. Next, 0.2 mL of polyethylene glycol 125 to 275 µm Hydropearls (Terumo Medical) were injected into the artery in the same manner with subsequent abolition of all vascular blush. No distal embolic complications surfaced. Hemostasis was obtained using manual pressure. Post procedure, patient had complete resolution of his pain.

Four months post embolic intervention patient reported a VAS score of 2 and an overall 75% relief in pain. He reported stiffness in the morning which faded as the day progressed and with use of his hands. Six months after the embolization, the patient can now open jars and is no longer reluctant to use his left hand. He reports there are some days where he feels absolutely no pain.

Case Report 3

A 63-year-old white female with a history of multi-joint osteoarthritis presented with continuing pain in the base of the right CMC and right third distal interphalangeal (DIP) joints. Patient was prescribed daily OxyContin for her life-limiting pain as there were no surgical options left for pain relief after a total joint arthroplasty. Secondary to the limited range of motion in her thumb, she had decreased power in the right hand, preventing her from using the right hand effectively. This daily pain prompted her to opt for right hand TAE.

Using ultrasound for guidance, the right radial artery was identified, and the overlying skin was infiltrated with lidocaine. Access into the right radial artery was then obtained in an antegrade fashion with the dilator of a pedal access 2.9 French micro puncture kit (Cook) followed by selective left radial angiography. 50 mcg of intra-arterial nitroglycerin was administered into the right radial artery supplying the CMC joint, followed by a saline flush. Angiography revealed significant blush at the level of the right CMC joint. A total of 0.5 mL of 100 to 300 µm Embospheres (Merit Medical) were injected into the artery meticulously in three intervals (0.2 mL + 0.1 mL + 0.2 mL). Abolition of abnormal blush followed the embolization. No distal embolic complications were noted, and hemostasis was obtained using manual pressure. One month post embolic intervention, patient reported she was able to use her right hand with minimal restriction and no discomfort, as well as a VAS score of 1. The patient also no longer needed to be prescribed OxyContin for her pain (Fig.2).

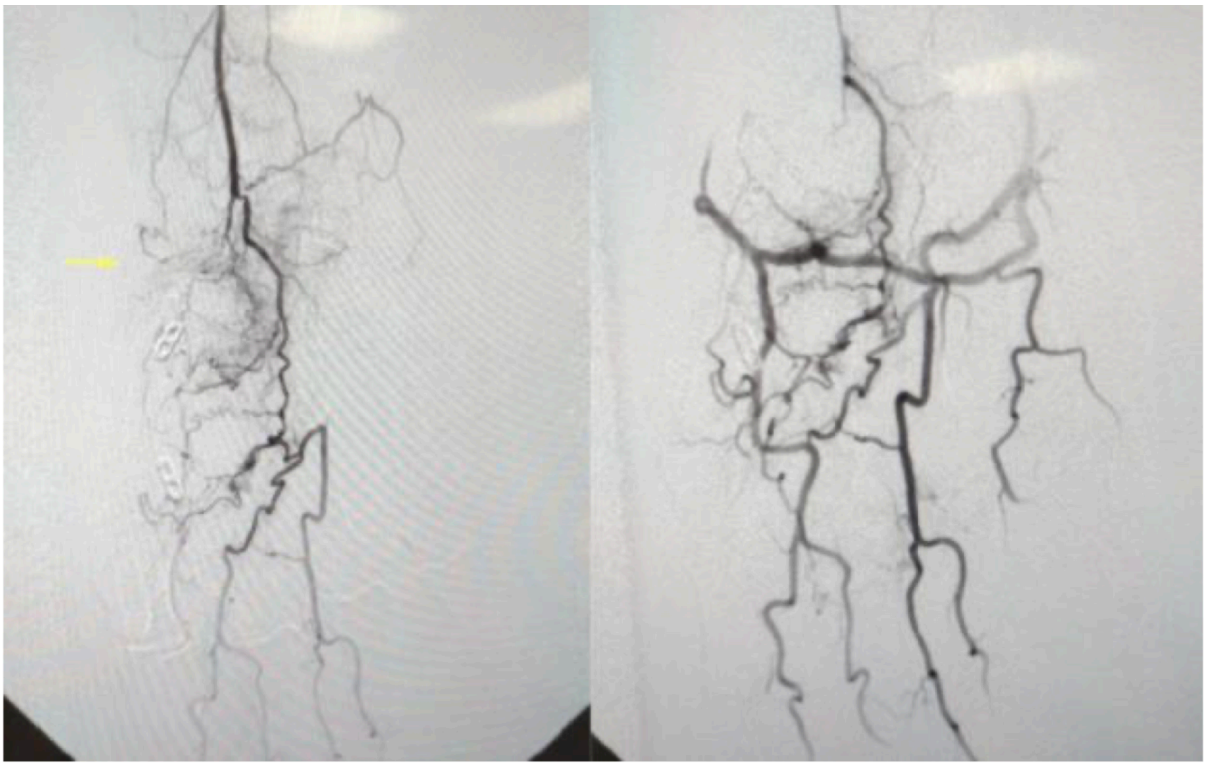

Figure 2: Case 3. (Left) Angiogram of the right first CMC and third DIP joints pre-embolic intervention. (Right) Angiogram of the right first CMC and third DIP joints post-embolic intervention.

Case Report 4

A 58-year-old Indian female presents with chronic right CMC joint osteoarthritis and has been treated by her orthopedic physician with physical therapy, pain medications, intra-articular steroids, and hand braces. Patient reported being physically active but is unable to perform daily activities that involve her right hand such as cooking or carrying household objects, as well as a baseline VAS score of 5.

Using ultrasound for guidance, the right radial artery was identified, and the overlying skin was infiltrated with lidocaine. Access into the right radial artery was then obtained in an antegrade fashion with the dilator of a pedal access 2.9 French micro puncture kit (Cook) followed by selective right radial angiography performed after 50 mcg of intra-arterial nitroglycerin, revealing significant blush. Subsequently, 0.4 mL of Imipenem-Cilastatin was slowly injected making sure that there was no stasis of the contrast-stained embolic particles. Repeat injection showed minimal blush at the first CMC joint that was treated with 0.1 mL of 100 to 300 µm Embospheres (Merit Medical). Repeat angiography showed no more blush (Fig.3). Manual pressure was applied to obtain hemostasis. No distal embolic complications were noted. One month post embolic intervention patient reported she was able to use her right hand with no limitations on daily activity or range of motion, as well as a VAS score of 0. The patient also no longer needed any pain medications for her thumb pain.

Discussion

This case series demonstrates the effectiveness of TAE as a treatment for hand joint pain due to OA. All patients in this study had clinical success, with each patient seeing a decrease in VAS scores of at least 75% over time, as well as a reduction in pain medication needed.

Reduction of medication frequency in all patients improves quality of life as dependency on pain medications requires frequent office visits while having the potential for breakthrough pain and side effects. The Eaton Classification uses radiographic images of the thumb to stage osteoarthritis of the CMC joint into 4 stages providing the ability to stratify the severity of thumb arthritis (10). Steroid injection and splinting as a conservative treatment for basal CMC joint OA of the thumb was effective and reliable for Eaton Stage I OA, but only had an efficacy of 41% for Eaton stages 2 and 3 (10). This indicates that steroid injections and splinting may not be effective in

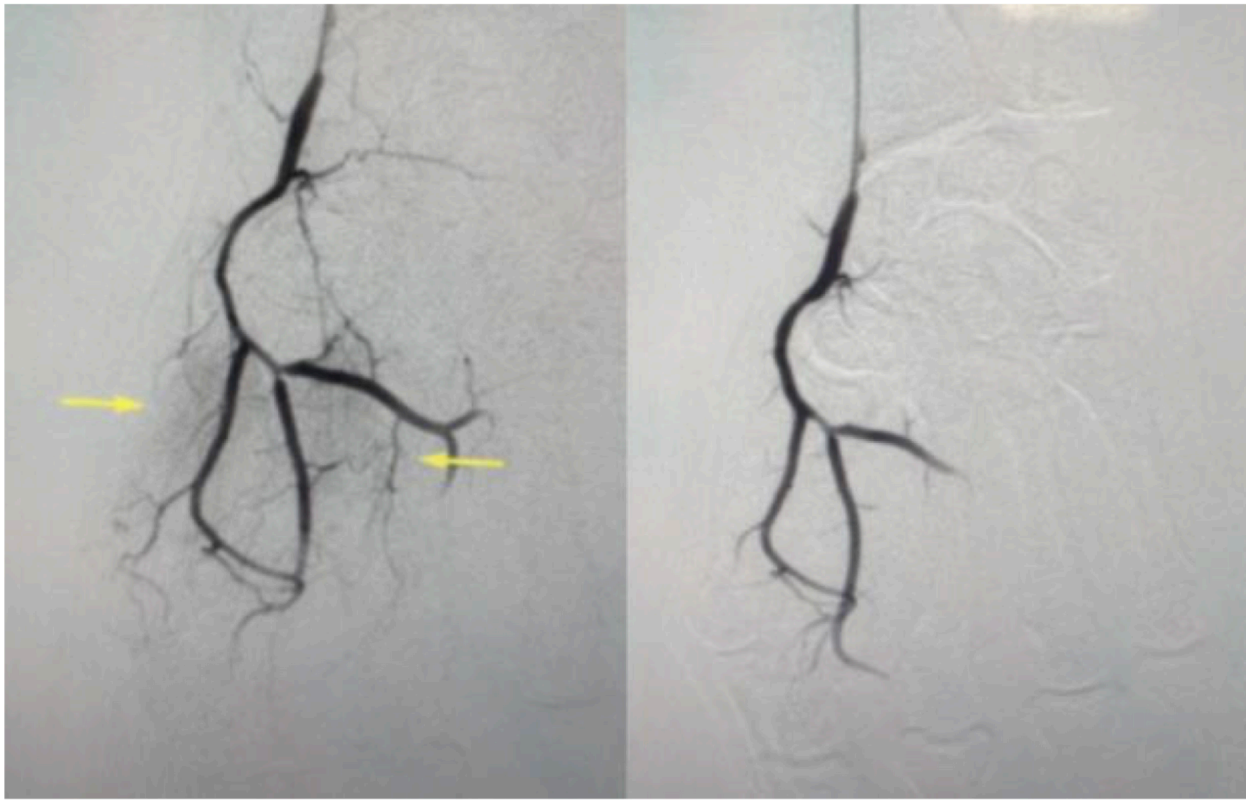

Figure 3: Case 4. [Left] Angiogram of the right CMC joint pre-embolic intervention. [Right] Angiogram of the right CMC joint post-embolic intervention.

patients who have more severe cases of osteoarthritis, prompting for the need for alternative treatments such as TAE.

The patients in Cases 1, 2, and 4 underwent unsuccessful steroid injection therapy before achieving significant symptom relief through arterial embolization. This improvement is reflected in the observed 75% decrease in each patient's VAS score from baseline to their most recent follow-up appointments. Both steroids and artery embolization offer rapid recovery when reducing inflammation due to their minimally invasive nature in comparison to surgery. However, steroid injections require frequent visits to maximize their efficacy, whereas TAE is, usually, a one-time procedure with at least, intermediate-term relief (11).

Additionally, qualitative data regarding functional use of the thumb showed patients were able to perform all activities without restriction of mobility or pain, suggesting that the intervention was sufficient to restore function without the need for additional physical or occupational therapy. However, for larger studies, incorporating standardized patient-reported outcome measures such as the EuroQol 5-dimension 5-level (EQ-5D-5L), Michigan Hand Outcomes Questionnaire (MHQ), or the Disabilities of Arm, Shoulder, and Hand Questionnaire (DASH), for a more comprehensive evaluation of the patient's daily lives (12). Additionally, objective function-related assessments, measuring range of motion, strength, grip, and pinch tests using instruments such as NK Hand Assessment System, can provide a uniform set of data between patients (9). Since this case series had a very small sample size, a patient-derived assessment of their daily activities was deemed adequate.

While TAE shows promise as an interventional procedure, the small sample size of this study is less likely to accurately represent the broader population. We expect that some patients may not benefit from artery embolization and should proceed with surgical intervention. Additionally, while VAS scores may be subjective between patients, comparing VAS scores from baseline to a post-procedure follow-up in a single patient confines the parameters, reducing variance. This limitation is important to consider when interpreting the pain outcomes. Future studies require a larger sample size to increase statistical power,

identify patients better suited for surgical intervention, and uncover nuances to fully realize the potential of TAE as a treatment option.

Conclusion

Our case series demonstrates that TAE shows promise as a viable treatment option for osteoarthritis-related pain. The procedure resulted in significant decreases in VAS and pain medication use and sustained improvements with daily activity with no unintended complications. However, due to the limited number of patients and the need for long-term data, further research is warranted to evaluate the long-term effects and comparative efficacy of artery embolization for carpometacarpal osteoarthritis against other treatment modalities.

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Funding

The author(s) received no financial support for the research, authorship, and/or publication of his article.

Acknowledgements

Authors: Nishanth Konduru, Sidhant Juneja, Samuel Joshua
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Ethical Approval

Ethical Approval to report this case series was obtained from WCG IRB (20241915)

Informed Consent

In this single-center case report, IRB waiver was received (a waiver of informed consent and a complete HIPAA waiver were granted) by the WCB IRB (ID 20241915) for the anonymized information to be published in this article.

Conflict of interest:

The authors declare that there were no conflicts of interest within the meaning of the recommendations of the International Committee of Medical Journal Editors when the article was written.

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