

Original Research Article

Short-term results of synovectomy and total knee arthroplasty in patients with diffuse-type pigmented villonodular synovitis

Aakash Bansal*, R. P. Meena, Prince Singh, Umesh Kumar Meena,
Bhavyaraj Singh Yadav, Rohit Kharalwa

Department of Orthopaedics, GMC Kota, Rajasthan, India

Received: 29 June 2025

Revised: 04 August 2025

Accepted: 11 August 2025

*Correspondence:

Dr. Aakash Bansal,

E-mail: aakashbansal.ac@gmail.com

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Background: Diffuse-type pigmented villonodular synovitis (D-PVNS) is a rare, benign proliferative condition that affects the knee joint, often leading to subchondral bone erosion, cyst formation, and ultimately secondary osteoarthritis. This study aimed to assess the short-term clinical outcomes of synovectomy combined with total knee arthroplasty (TKA) in patients diagnosed with D-PVNS.

Methods: This study was conducted in the department of orthopaedics at government medical college, Kota, between 2020 and 2025, 28 patients with histopathologically confirmed D-PVNS of the knee underwent synovectomy followed by TKA. Clinical and operative data were recorded perioperatively and throughout follow-up to evaluate surgical effectiveness.

Results: There were no intraoperative complications. The mean operative time was 73.4 minutes (range: 47-115 minutes), and the average estimated blood loss was 223.9 mL (range: 50-600 mL). Patients were followed up for an average of 58.7 months (range: 36-84 months). Range of motion improved from a mean of $86.1^{\circ} \pm 11.3^{\circ}$ preoperatively (range: 60° - 100°) to $107^{\circ} \pm 11.4^{\circ}$ postoperatively (range: 90° - 130°). The average knee society clinical score increased from 38.9 ± 9.5 to 84.4 ± 6.1 , while the functional score improved from 48.9 ± 13.1 to 84.6 ± 6.1 ($p < 0.05$). Postoperative radiographs revealed no signs of prosthesis loosening, dislocation, or periprosthetic fracture.

Conclusions: Synovectomy combined with total knee replacement offers favorable short-term outcomes in managing D-PVNS of the knee, with significant improvements in joint function and stability and no major complications observed during follow-up.

Keywords: Total knee replacement, Synovectomy, Diffuse pigmented villonodular synovitis

INTRODUCTION

Pigmented villonodular synovitis (PVNS), also referred to as diffuse-type giant cell tumor, is a rare, non-cancerous condition affecting the synovial lining of joints. It typically presents in a single joint, with the knee being the most commonly involved site (reported in 28-70% of cases), followed by the hip and ankle.¹ PVNS is classified into two distinct forms: localized PVNS (L-PVNS) and D-PVNS. While these subtypes differ in their clinical and imaging characteristics, they share identical histopathological

features.²⁻⁴ D-PVNS is the more prevalent variant and typically follows a chronic course.⁵ Its clinical presentation is diverse but often involves the entire knee joint, resulting in more pronounced functional impairment compared to the localized form.⁶ D-PVNS frequently causes subchondral bone erosion and the development of cysts, eventually progressing to osteoarthritis. The standard approach to management involves complete surgical excision of the affected synovial tissue, which can be performed through arthroscopic or open total synovectomy, arthrodesis, or joint replacement.⁷ Despite

treatment, recurrence rates remain significant, ranging between 14% and 55%. In cases where the joint exhibits advanced pathological changes-such as bone erosion, formation of subchondral cysts, or overall joint space narrowing-performing an arthroscopic or open total synovectomy alone is often insufficient. Under such circumstances, TKA serves as a more appropriate intervention to restore joint function and address structural damage. This study was conducted to assess the short-term outcomes of patients diagnosed with D-PVNS who underwent both synovectomy and total knee replacement.

METHODS

The study was conducted at the government medical college, Kota, between January 2020 and January 2025. A retrospective analysis was conducted on patients diagnosed with D-PVNS who underwent TKA at our center.

Inclusion criteria

A confirmed diagnosis of PVNS based on histopathological evaluation, with the diffuse variant established through MRI findings or intraoperative observations, treatment involving both synovectomy and total knee replacement were included.

A total of 28 patients met these criteria. Clinical data were retrieved from orthopedic and pathology department records with preoperative X-ray (Figure 1). Postoperative follow-up assessments were scheduled at 1, 3, 6, and 12 months, followed by annual evaluations. For patients unable to attend in-person follow-ups, their most recent clinical review was considered the final follow-up.

Exclusion criteria

Patients were excluded from the study if they met any of the following criteria: Incomplete medical records or missing follow-up data, diagnosis of localized PVNS rather than diffuse type, PVNS involving joints other than the knee, history of prior knee arthroplasty or major knee surgery, presence of concurrent malignant or infectious joint pathology and patients who underwent synovectomy without total knee replacement.

Surgical technique and postoperative management

In all cases, a cemented, posterior-cruciate-substituting total knee prosthesis was implanted. One experienced orthopedic surgeons performed the procedures using standard surgical techniques.⁸ When intraoperative inspection revealed suspicious or abnormal synovial tissue (Figure 2), an extensive synovectomy was carried out. Total synovectomy was performed following joint exposure and osteotomy.⁹

After the joint was exposed, all visible pathological synovium was meticulously excised from around the

patella, as well as from the medial and lateral compartments of the tibiofemoral joint and the posterior capsule. Once the posterior cruciate ligament was excised during osteotomy, the remaining posterior synovium was removed using blunt dissection. Special attention was given to ensure complete excision of diseased tissue to minimize the risk of recurrence.¹⁰ Excised synovial tissue was sent for histopathological analysis. A standard TKA was then completed (Figure 3). A drain was inserted, and the surgical wound was closed in layers.



Figure 1: Preop X-ray show osteoarthritis knee with soft tissue swelling.

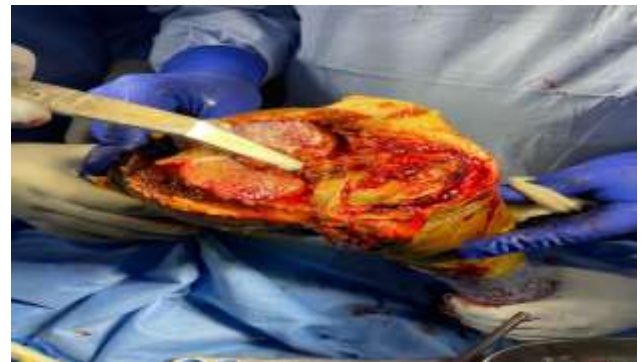


Figure 2: Intraoperative photo shows polypoidal like projections.



Figure 3: Intraoperative photo after synovectomy and total knee replacement.

Postoperatively, patients received intravenous cefazolin for 48 hours as antibiotic prophylaxis. Rivaroxaban was prescribed as thromboprophylaxis for two weeks. Early mobilization was encouraged, with in-bed movement beginning on the first postoperative day. Ambulation with toe-touch weight-bearing using crutches was initiated after drain removal. No adjuvant radiotherapy was administered. There was uniformity in intraoperative and postoperative care across all patients.

Evaluation

Clinical data were collected at three time points: preoperatively, postoperatively, and throughout the follow-up period. Parameters assessed included operative duration, estimated intraoperative blood loss, postoperative complications, length of hospital stay, recurrence rates, duration of follow-up, and functional knee scores (on a scale of 0 to 100, with higher scores indicating better function). Standardized standing anteroposterior and lateral radiographs were obtained postoperatively to evaluate prosthesis positioning and integrity (Figure 4). Recurrence was suspected in patients who presented with unexplained symptoms such as increased joint pain, reduced range of motion, or the presence of a new palpable mass. In such cases, magnetic resonance imaging (MRI) was performed to confirm recurrence and to localize any new areas of PVNS infiltration.



Figure 4: Postop X-ray.

Statistical analysis

Data analysis was conducted using IBM SPSS statistics for Windows, version 19.0 (IBM Corp., Armonk, NY, USA). Paired t-tests were used to compare preoperative and postoperative values for knee flexion and extension, as well as Knee Society clinical and functional scores. A p value of less than 0.05 was considered statistically significant.

RESULTS

A total of 28 patients (7 males and 21 females) diagnosed with D-PVNS underwent TKA at our institution. In total, 36 knee joints were treated-20 patients had unilateral involvement, while 8 presented with bilateral osteoarthritis requiring knee replacement. Of the 36 joints, 29 were affected by D-PVNS: 1 patient had bilateral knee involvement, 16 had disease limited to the left knee, and 11 to the right.

The mean age at the time of surgery was 61.9 years (range: 48-81 years). All patients reported symptoms including varying degrees of knee pain, swelling, and restricted mobility. Ten patients had a history of prior knee trauma on the affected side, and four of these had previously undergone arthroscopic intervention before proceeding to knee replacement as shown in Table 1.

Table 1: Demographic data of patients.

Parameters	Values, N (%)
Total no. of patients	28
Total knee joints operated	36
Gender distribution	7 males (25), 21 females (75)
Mean age at surgery	61.9±9.1 (Range: 48-81)
Knees affected by D-PVNS	29 out of 36
History of prior knee trauma	10 patients (35.7)
Previous arthroscopy	4 patients (14.3)
Laterality of knee involvement	Unilateral: 20 patients (71.4) Bilateral: 8 patients (28.6)
Side of involvement (D-PVNS knees)	Left: 16 Right: 11 Bilateral: 1

The average preoperative range of motion was 86.1±11.3 degrees (range: 60-100 degrees). Mean knee society scores prior to surgery were 38.9±9.5 (range: 17-54) for the clinical component and 48.9±13.1 (range: 25-80) for the functional component. Radiographic imaging revealed significant joint space narrowing and erosive bone lesions in all cases. Preoperative diagnosis of D-PVNS was established via MRI or histopathology in 5 patients, while the remaining 23 were diagnosed intraoperatively through histopathological evaluation of synovial tissue.

All surgeries were completed without intraoperative complications. Intraoperatively, the affected synovial tissue appeared dark red to yellow-brown and was excised entirely. The diagnosis of D-PVNS was confirmed through histopathological examination of the excised tissue. The mean operative time was 73.4 minutes (range: 47-115 minutes), and the average estimated blood loss was 223.9 mL (range: 50-600 mL). None of the patients required

homologous blood transfusion during their hospital stay. The average duration of hospitalization was 8.1 days (range: 5-12 days). No postoperative complications were observed, including nerve injury, wound healing issues, or deep vein thrombosis. All patients completed long-term follow-up, with an average follow-up period of 58.7 months (range: 36-84 months). At final follow-up, the mean range of motion improved to 107 ± 11.4 degrees (range: 90-130 degrees) (Figure 5 and 6). Knee society scores showed significant improvement postoperatively: the mean clinical score rose to 84.4 ± 6.1 (range: 75-98), and the mean functional score reached 84.6 (range: 75-95), with both improvements statistically significant ($p < 0.05$; Table 2).



Figure 5: Postop knee flexion movement.



Figure 6: Postop knee extension movement.

Follow-up radiographs revealed no evidence of prosthesis loosening, dislocation, or periprosthetic fracture. No cases of D-PVNS recurrence were identified, and no revision surgeries were required during the follow-up period.

Table 2: Patient outcomes.

Patient outcomes	Points		
	Pre-operative	Post-operative	P value
Range of motion	86.1 ± 11.3 degrees	107 ± 11.4 degrees	<0.001
Knee society clinical scores	38.9 ± 9.5	84.4 ± 6.1	<0.001
Knee society functional scores	48.9 ± 13.1	84.6 ± 6.1	<0.001

DISCUSSION

D-PVNS is an uncommon, benign condition affecting the synovium and tendon sheaths, with involvement of multiple joints being exceedingly rare.^{11,12} In our study cohort, 27 patients exhibited monoarticular disease, while only one case showed bilateral knee involvement. Although the exact cause of PVNS remains uncertain, several factors such as genetic mutations, prior trauma, and hemorrhagic events have been implicated. Repeated synovial trauma is among the theories suggested to contribute to its development.¹³ In this series of 28 patients, 10 reported a history of trauma. The clinical diagnosis of D-PVNS can be challenging due to its variable and often non-specific symptomatology. Patients with D-PVNS commonly exhibit symptoms such as chronic low to moderate joint pain, swelling due to joint effusion or synovial hypertrophy, limited range of motion, and occasionally a palpable mass.¹⁴ However, these symptoms are often vague and nonspecific, which contributes to significant delays in diagnosis. The time between symptom onset and definitive diagnosis can extend from several months to even years. As the condition progresses, what may initially be a localized process can evolve into a diffuse form, infiltrating surrounding structures like bone, muscle, and tendons, ultimately leading to degenerative joint changes and arthritis. In the current study, all 28 patients initially presented with a diagnosis of osteoarthritis. Only five were identified as having D-PVNS prior to surgery, while the remaining 23 cases were diagnosed intraoperatively through frozen section pathology during TKA. This low rate of preoperative detection reflects the diagnostic challenges posed by the indolent nature of the disease. Early diagnosis is uncommon, and in many cases, bone involvement is already present by the time the condition is recognized.¹⁵ D-PVNS tends to be more extensive and invasive compared to the L-PVNS. Recurrence rates in D-PVNS are notably high, with reported relapse ranging between 14% and 55%.¹⁶⁻¹⁹ Various treatment modalities have been explored, including open surgery, arthroscopy, and hybrid approaches.²⁰⁻²¹ However, complete surgical excision of the affected synovium remains the cornerstone of effective treatment and is most reliably achieved through an open surgical approach. Achieving total removal of the diseased synovial tissue is critical to minimizing recurrence risk and

ensuring a successful outcome.^{22,23} In cases where D-PVNS has led to advanced degenerative changes in the joint, synovectomy alone is often insufficient, and outcomes tend to be poor without addressing the underlying joint damage. TKA, a commonly preferred treatment for advanced degenerative joint disease, is also a suitable option for patients with knee D-PVNS accompanied by significant joint destruction, particularly when there is extensive cartilage damage.²⁴ Performing TKA allows for wide exposure of the joint through bone cuts, thereby enabling a more complete synovectomy. This facilitates maximal removal of pathological synovial tissue, which may help reduce the likelihood of recurrence. In this series, all patients received posterior-stabilized prostheses. This design was chosen because resection of the posterior cruciate ligament enhances access for thorough synovial excision. While some reports suggest that extensive synovectomy may lead to increased bleeding, longer operative times, and a higher risk of postoperative hemarthrosis, our experience did not show significant differences in average surgical duration or estimated blood loss.²⁵ However, as this study did not include a control group, the ability to draw firm conclusions is limited.

Limitations

This study has certain limitations. Firstly, the sample size was relatively small, which may limit the generalizability of the findings to broader populations or different geographical regions. Secondly, the duration of follow-up was short, restricting insights into long-term outcomes. Further research with extended follow-up is necessary to assess recurrence rates, the need for revision surgeries, and the sustained effectiveness of the treatment approach.

CONCLUSION

Synovectomy combined with total knee replacement offers favorable short-term outcomes in managing diffuse-type PVNS of the knee, with significant improvements in joint function and stability and no major complications observed during follow-up. The short-term efficacy of synovectomy and total knee replacement in treating patients with D-PVNS was satisfactory.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Miller WE. Villonodular synovitis: pigmented and nonpigmented variations. *South Med J*. 1982;75(09):1084-6.
2. Granowitz SP, Mankin HJ. Localized pigmented villonodular synovitis of the knee. Report of five cases. *J Bone Joint Surg Am*. 1967;49 (01):122-8.
3. Murphey MD, Rhee JH, Lewis RB, Fanburg-Smith JC, Flemming DJ, Walker EA. Pigmented villonodular synovitis: radiologic-pathologic correlation. *Radiographics*. 2008;28(05):1493-518.
4. Frassica FJ, Khanna JA, McCarthy EF. The role of MR imaging in soft tissue tumor evaluation: perspective of the orthopedic oncologist and musculoskeletal pathologist. *Magn Reson Imaging Clin N Am*. 2000;8(04):915-27.
5. Schreuder HW. Long-term follow-up results of primary and recurrent pigmented villonodular synovitis. *Rheumatology (Oxford)*. 2014;53(11):2063-70.
6. Flandry F, Hughston JC, McCann SB, Kurtz DM. Diagnostic features of diffuse pigmented villonodular synovitis of the knee. *Clin Orthop Relat Res*. 1994;(298):212-20.
7. Chin KR, Barr SJ, Winalski C, Zurakowski D, Brick GW. Treatment of advanced primary and recurrent diffuse pigmented villonodular synovitis of the knee. *J Bone Joint Surg Am*. 2002;84(12):2192-202.
8. Muñoz FA, Gonzalez-Navarro B, Lopez-Prats FA. Cruciate-retaining vs posterior-stabilized primary total arthroplasty. clinical outcome comparison with a minimum follow-up of 10 years. *J Arthroplasty* 2018;33(08):2491-5.
9. Lei P, Sun R, Liu H, Zhu J, Wen T, Hu Y. Prognosis of advanced tenosynovial giant cell tumor of the knee diagnosed during total knee arthroplasty. *J Arthroplasty*. 2017;32(06):1850-5.
10. Flandry FC, Hughston JC, Jacobson KE, Barrack RL, McCann SB, Kurtz DM. Surgical treatment of diffuse pigmented villonodular synovitis of the knee. *Clin Orthop Relat Res*. 1994;(300):183-92.
11. Safaee M, Oh T, Sun MZ, Andrew TP, McDermott MW, El-Sayed IH, et al. Pigmented villonodular synovitis of the temporomandibular joint with intracranial extension: a case series and systematic review. *Head Neck*. 2015;37(08):1213-24.
12. True VL, Monsell FP, Smith TA, Simon CP, David JG, Marion ES, et al. A severe systemic presentation of pigmented villonodular synovitis in a child with underlying Chediak-Higashi syndrome. *J Pediatr Orthop B*. 2015;24(06):526-9.
13. Ottaviani S, Ayril X, Dougados M, Gossec L. Pigmented villonodular synovitis: a retrospective single-center study of 122 cases and review of the literature. *Semin Arthritis Rheum*. 2011;40(06):539-46.
14. de Carvalho LH Jr, Soares LF, Gonçalves MB, Temponi EF, de MeloSilva O Jr. Long-term success in the treatment of diffuse pigmented villonodular synovitis of the knee with subtotal synovectomy and radiotherapy. *Arthroscopy*. 2012;28(09):1271-4.
15. Nishida Y, Tsukushi S, Nakashima H, Hideshi S, Yoshihisa Y, Hiroshi U, et al. Osteochondral destruction in pigmented villonodular synovitis during the clinical course. *J Rheumatol*. 2012;39(02):345-51.

16. Palmerini E, Staals EL, Maki RG, Stefano P, Angela C, Marco G, et al. Tenosynovial giant cell tumour/pigmented villonodular synovitis: outcome of 294 patients before the era of kinase inhibitors. *Eur J Cancer.* 2015;51(02):210-17.
17. Chiari C, Pirich C, Brannath W, Kotz R, Trieb K. What affects the recurrence and clinical outcome of pigmented villonodular synovitis? *Clin Orthop Relat Res.* 2006;450(450):172-8.
18. Chin KR, Brick GW. Extraarticular pigmented villonodular synovitis: a cause for failed knee arthroscopy. *Clin Orthop Relat Res.* 2002;(404):330-8.
19. Staals EL, Ferrari S, Donati DM, Palmerini E. Diffuse-type tenosynovial giant cell tumour: Current treatment concepts and future perspectives. *Eur J Cancer.* 2016;63:34-40.
20. Loriaut P, Djian P, Boyer T, Bonvarlet JP, Delin C, Makridis KG. Arthroscopic treatment of localized pigmented villonodular synovitis of the knee. *Knee Surg Sports Traumatol Arthrosc.* 2012;20(08):1550-3.
21. Colman MW, Ye J, Weiss KR, Goodman MA, McGough RL III. Does combined open and arthroscopic synovectomy for diffuse PVNS of the knee improve recurrence rates? *Clin Orthop Relat Res.* 2013;471(03):883-90.
22. Flandry F, Hughston JC. Pigmented villonodular synovitis. *J Bone Joint Surg Am.* 1987;69(06):942-9.
23. Mankin H, Trahan C, Hornicek F. Pigmented villonodular synovitis of joints. *J Surg Oncol.* 2011;103(05):386-9.
24. Hamlin BR, Duffy GP, Trousdale RT, Morrey BF. Total knee arthroplasty in patients who have pigmented villonodular synovitis. *J Bone Joint Surg Am.* 1998;80(01):76-82.
25. Houdek MT, Scorianz M, Wyles CC, Trousdale RT, Sim FH, Taunton MJ. Long-term outcome of knee arthroplasty in the setting of pigmented villonodular synovitis. *Knee.* 2017;24(04):851-5.

Cite this article as: Bansal A, Meena RP, Singh P, Meena UK, Yadav BS, Kharalwa R. Short-term results of synovectomy and total knee arthroplasty in patients with diffuse-type pigmented villonodular synovitis. *Int J Res Orthop* 2025;11:1155-60.