

Outcomes of Diffuse-Type Pigmented Villonodular Synovitis (PVNS) after Open Total Synovectomy

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Purpose: Pigmented villonodular synovitis (PVNS) is a rare soft tissue tumor, which usually arises in larger joints, such as the knee. It has a high recurrence rate after surgical treatment. The purpose of this study is to evaluate and analyze the clinical results of diffuse-type pigmented villonodular synovitis cases that were treated with open total synovectomy.

Materials and Methods: Between 1994 and 2006, 21 patients who had diffuse-type pigmented villonodular synovitis were selectively reviewed. Among the 21 cases studied, 14 patients presented at the knee, 5 at the ankle, and 2 at the shoulder and elbow. The mean follow up period was 5.5 years (range, 36-157 months). The average age of the patients was 34 years consist of 7 men and 14 women. Clinical outcomes were analyzed retrospectively, including range of motion and complications.

Results: Open total synovectomy and adjuvant electrocauterization were done in all cases except one. During the regular follow-up period after the surgery, two patients showed symptoms of recurrence. After re-operation, only one case was pathologically confirmed as a recurrence. The patient who had partial synovectomy and the other patient who had second operation due to recurrence received additional radiation therapy. Clinical outcome scores were improved in every aspect ($p < 0.0001$). 2 out of 14 Patients who had pigmented villonodular synovitis at the knee developed stiff knee after the surgery.

Conclusion: After the open total synovectomy with electrocauterization, a low recurrence rate and satisfactory clinical outcome was achieved, observed in a minimum of 3 years of follow-up.

Key words: synovitis, pigmented villonodular, open total synovectomy

Introduction

Due to its unknown etiology, pigmented villonodular synovitis (PVNS) had has also been termed synovial fibroendelioma, chronic hemorrhagic villous synovitis, or fibrohemisideric sarcoma. In 1941, based on its histologic findings, Jaffe, Lichtenstein and Sutro first used the the term 'PVNS', but the pathogenesis is still not clear.^{1,2)} The annual incidence of PVNS is 1.8 patients per million in the population, which is why reporting of PVNS was rare in a large scale study.³⁻⁵⁾

Compared to localized PVNS, diffuse-type PVNS permeates

to the bone and surrounding soft tissues, which results in destruction of major joints.^{2,3,5-8)} The high recurrence rate after surgical removal has been a major concern.^{2,3,6-11)} Radiation or intra-articular radioisotope injection has been attempted to solve this problem, but the efficacy and indications of this method are still not established.^{2,5-7,12-18)} The purpose of this study is to evaluate and analyze the clinical outcomes of diffuse-type PVNS that were treated with open synovectomy and additional electrocauterization. In addition, the value of radiation therapy to prevent recurrence is examined.

Materials and Methods

1. Patient characteristics

From February 1994 to March 2006, 32 patients were diagnosed as PVNS. Histological confirmation was done in all cases. Cases with a follow-up of less than 3 years and localized-type were excluded. In all, 21 cases of diffuse-type PVNS were reviewed.

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Table 1. Summary of Cases

No	Age/ Sex	Site	Trauma	Previous surgery	Surgical method (approach)	RTx.	Compli- cation	F/U (month)	Recurrence
1	40/F	Left shoulder	No	Once: arthroscopy 92-11 (YUMC)	Open total synovectomy, Electrocauterization (Anterior)	(-)	None	43	No
2	38/F	Right elbow	No	Once: arthroscopy 92-07 (YUMC)	Open total synovectomy, Electrocauterization (Anterior+posterior)	(-)	None	62	No
3	7/F	Left knee	No	(-)	Open total synovectomy, Electrocauterization (Popliteal fossa)	(-)	None	41	No
4	43/F	Right knee	No	*Twice: arthroscopy 92-10 1st op 97-04 2nd op	Open total synovectomy, Electrocauterization (Anterior+popliteal fossa)	(-)	Pain swelling	41	No
5	20/M	Left knee	No	(-)	Open total synovectomy, Electrocauterization (Anterior)	(-)	Pain	44	No
6	37/F	Left knee	No	(-)	Open total synovectomy, Electrocauterization (Popliteal fossa)	(-)	None	54	No
7	38/F	Left knee	No	(-)	Open total synovectomy, Electrocauterization (Anterior)	(-)	None	78	No
8	25/F	Left knee	No	(-)	Open total synovectomy, Electrocauterization (Anterior+popliteal fossa)	(-)	None	87	Re-operation pathology (-)
9	47/F	Left knee	No	*Once: open excision 01-12	Open total synovectomy, Electrocauterization (Anterior+popliteal fossa)	(-)	None	75	No
10	31/F	Right knee	No	(-)	Open total synovectomy, Electrocauterization (Anterior+popliteal fossa)	(+) after 2nd op.	LOM	36	Yes
11	44/F	Left knee	No	Once: arthroscopy 04-11 (YUMC)	Open total synovectomy, Electrocauterization (Popliteal fossa)	(-)	None	44	No
12	15/M	Left knee	No	*Three times: arthroscopy 03-11 1st op 04-02 2nd op 04-10 3rd op	Open total synovectomy, Electrocauterization (Anterior+popliteal fossa)	(-)	Stiff knee (0-45)	38	No
13	42/M	Left knee	No	Twice: open excision (unknown)	Open total synovectomy, Electrocauterization (Anterior)	(-)	Stiff knee (15-70)	36	No
14	13/M	Right knee	No	(-)	Open total synovectomy, Electrocauterization (Anterior)	(-)	Swelling	41	No
15	39/M	Left knee	No	(-)	Open total synovectomy, Electrocauterization (Popliteal fossa)	(-)	None	36	No
16	54/F	Right knee	No	Once: open excision (unknown)	Open partial synovectomy, Electrocauterization (Popliteal fossa)	(+)	LOM	37	No
17	42/F	Right ankle	No	*Once: open excision 95-6	Open total synovectomy, Electrocauterization (Anterolateral+posteromedial)	(-)	None	157	No
18	42/F	Left ankle	No	Once: open excision 92-09 (at local hospital)	Open total synovectomy, Electrocauterization (Anterolateral+posterolateral)	(-)	None	133	No

Table 1. Continued

No	Age/ Sex	Site	Trauma	Previous surgery	Surgical method (approach)	RTx.	Compli- cation	F/U (month)	Recurrence
19	36M	Left ankle	Yes	(-)	Open total synovectomy, Electrocauterization (Anterolateral+posterolateral)	(-)	LOM	135	No
20	43/F	Right ankle	No	(-)	Open total synovectomy, Electrocauterization (Anterolateral+posterolateral)	(-)	None	38	No
21	19/M	Right ankle	No	(-)	Open total synovectomy, Electrocauterization (Anterolateral+posteromedial)	(-)	Pain	58	No

RTx, radiation therapy; Op, operation; LOM, limitation of motion; YUMC, Yonsei university college of medicine.

*Referal from other tertiary medical center.

The medical records, age at presentation, sex, initial symptoms and durations, history of trauma, previous operation methods, and the number of operations was reviewed. The duration of follow-up was calculated from the date of surgery to the last follow-up. Through the medical records and the interviews, post-operative complications, recurrence, and treatment details were also collected. The correlation between the initial treatment method and the recurrence was examined. During the follow-up period, the patients who presented clinical suspicion of recurrence, by symptoms, and imaging studies, underwent re-operation. The mean follow-up was 65 months (range, 36–157 months). There were seven men (33%) and fourteen women (67%), with an average age of 34 years (range, 7–54 years). Of the 21 patients, 10 patients were referred for further treatment after a previous operation due to recurrence. 7 patients were referred from other hospitals after recurrences. The other 3 patients were referred from our arthroscopic division, and the patients had PVNS recur after arthroscopic removal. There was one patient who had three incidences of recurrence; at the each recurrence, this patient had arthroscopic removal. Two patients had been referred after two times of recurrence. One patient had arthroscopic removal, and the other had an open procedure. There were a total of 7 patients who had one recurrence before the referral. Among the 7 patients, 3 had a history of arthroscopic removal (Table 1).

2. Surgical method and rehabilitation

All of patients were first treated by an open synovectomy. All of the total synovectomy were performed by only one surgeon (Corresponding author). After removing as much of the synovium as possible, additional electrocauterization was done at the base and surrounding soft tissues. There was one referral patient

who had severe postoperative fibrosis and tethering around the neurovascular bundle in the popliteal fossa, which made it impossible to perform total synovectomy. This patient had additional radiation therapy after surgery. A total of 3,000 cGY radiation therapy was done in fifteen rounds of radiation.

The anterior median parapatella approach and the posterior transpopliteal approach were used to treat 14 patients who had a mass at the knee. If the mass was located both anterior and posterior, the posterior mass was removed first, followed by the removal of the anterior one 6 to 8 weeks later. 5 patients received both the anterior and posterior surgeries. For surgery on the anterior, the curvilinear incision was started 1 to 2 cm above the superior pole of the patella, along the medial margin of the patella (Fig. 1B). After incising the anterior capsule, the synovium, including the mass, was exposed. En bloc total synovectomy was done when possible. The anterior cruciate ligament, subpatellar fat pad, medial and lateral gutter, and the menisci was the region where careful inspection was done, because those are the places where the small foci of PVNS could be neglected.^{17,19} If the patient had a history of arthroscopic surgery, the previous entry portals were also carefully examined. When using the posterior approach, the prone position was used. The incision was began 5 cm above the joint line, at the medial corner of the popliteal area, and extended distally until the proximal portion of the gastrocnemius was exposed, such that the incision formed an 'S' shape. The popliteal artery, tibial nerve, and common peroneal nerve were protected during dissection (Fig. 1C). If possible, a branch of the sural nerve was also saved. Anterolateral, posterolateral, posteromedial approach were used to achieve total synovectomy at the ankle joint. After preserving superficial peroneal nerve, extensor digitorum longus tendon



Figure 1. MRI and gross photos representing the diffuse type PVNS located in anterior and posterior aspect of the knee. (A) Pre-operative MRI revealing diffuse mass on anterior and posterior aspect of the knee. (B) Intra-operative findings after an anterior medial para patella approach. (C) Intra-operative findings after a posterior popliteal approach. (D) Gross photo of pathology.

was retracted medially with neurovascular bundle. By incising proximal portion of extensor digitorum brevis and fat pad at Sinus tarsi, wide exposure of anterior to lateral aspect of ankle joint was possible including calcaneocuboid joint and medial half of talonavicular joint. If needed additional posterolateral or posteromedial approach was done after changing patient to the prone position (Fig. 2). There were two cases on the upper extremity. Anterior approach was used to remove the mass on the shoulder (Fig. 3) and extended posterior and anterior approach was used to perform total synovectomy at the elbow.

A posterior splint was applied immediately after operation, and removed 2–4 days later when the drain was removed. Rehabilitation started with passive range of motion (ROM) exercises and vigorous active assisted ROM exercises were done by a physiotherapist for 1 month. Especially for the patient who had a surgery at knee, quadriceps strengthening exercises, while sitting on a bed or chair was emphasized.

3. Assessment

Regular follow-up was done after the surgery at 2 months, 4 months, 6 months, and annually. At every annual follow-up, the

functional clinical outcome was assessed by checking pain, range of motion, symptoms, and activity of daily living (ADL), which was suggested by Ogilvie–Harris,²⁰ as modified from Laurin's proposal (Table 2). We compared scores a 3 year follow-up period to pre-operative scores. Recent symptoms and satisfaction with the surgery were checked by telephone interviews.

SAS v. 9.1 (SAS Inc., North Carolina), the chi-square test, the paired *t*-test, and one-way ANOVA were used for statistical analysis.

Results

There were 7 male and 14 female patients. Females were predominant in a two to one ratio, but this was not statistically significant ($p=0.126$). The knee joint was the most commonly occurring site (14 cases), followed by 5 cases at the ankle joint, and 2 cases at the upper extremity. 14 patients (66%) complained of a palpable mass at the presentation, which was the most common symptom (Table 3). Only the one patient had a history of trauma before the initiation of symptoms.

During the follow-up period, which was a mean of 65 months

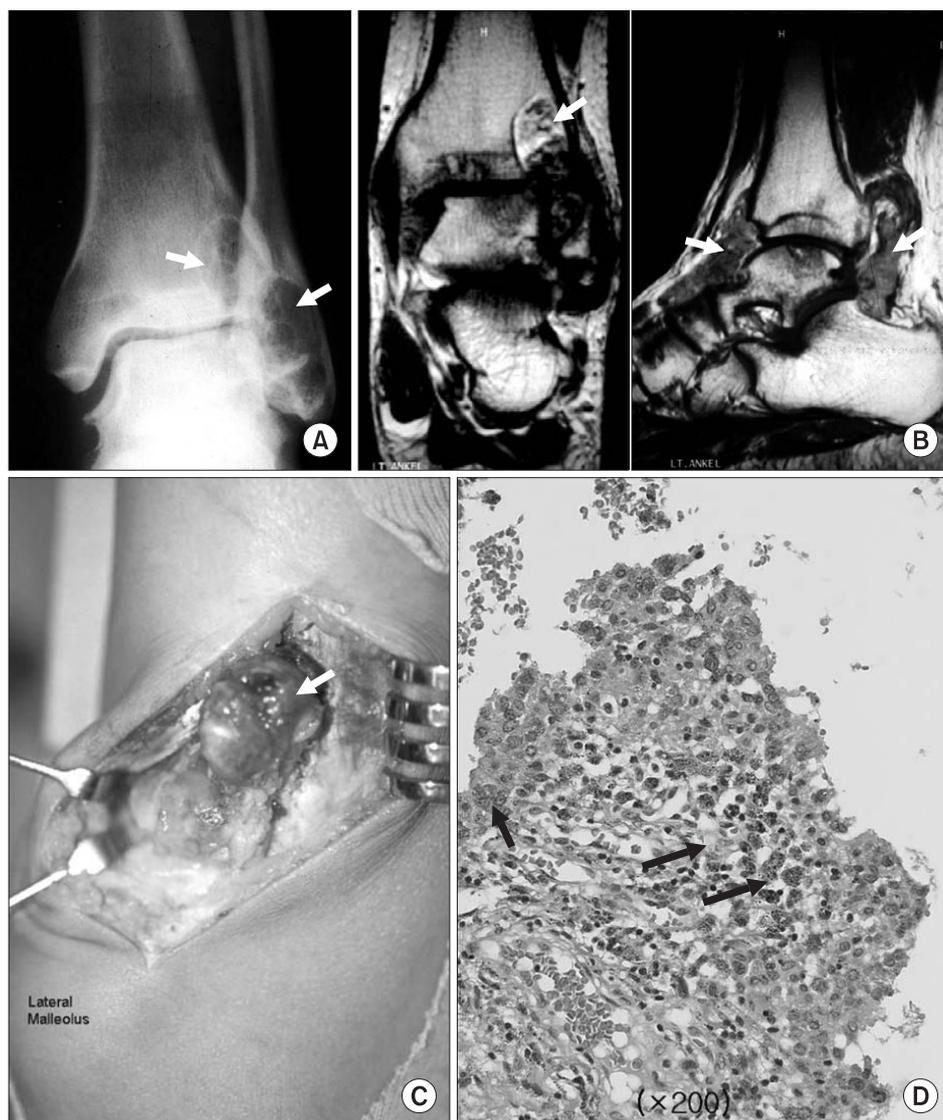


Figure 2. A 36 year old male who had diffuse-type PVNS in his left ankle. (A) Pre-operative x-ray presenting radiolucent lesions on distal fibular and tibia. (B) Pre-operative MRI images showing diffuse mass on anterior and posterior aspect of the ankle. (C) Intra-operative gross findings after a posterolateral approach. (D) Microscopic findings present synovial-like mononuclear cells, hemosiderin laden macrophages, foam cells and giant cells which are consistent findings of PVNS (H&E stain).

(range, 36–157 months), two patients had a clinical suspicion of recurrence. Both suspected recurrences had symptoms of swelling and pain. Follow-up MRI revealed equivocal findings to the previous operation field, so re-operation was done. Histologic confirmation was also done to identify recurrence after the re-operation. Of the two patients, only one patient showed histologic confirmation of recurrence. This patient had radiation therapy after re-operation. The other patient presented non-specific chronic synovial inflammation, which resolved after 3 months of conservative treatment. The functional clinical outcome assessment, as suggested by Ogilvie-Harris, showed improvement in all aspects after the surgery (Table 4). By comparing scores from 3 years post-operative to pre-operative scores, pain ($p=0.0001$), swelling ($p=0.0009$), range of

motion ($p=0.0004$), function ($p<0.0001$), and total ($p<0.0001$) scores showed statistically significant improvement. 11 patients (10: referral from other hospitals, 1: received initial surgery by the author) who had re-operation due to recurrence presented overall low scores in all the categories, as compared to the other patients, though the scores were not statistically significant (pain: $p=0.844$, swelling: $p=0.656$, range of motion: $p=0.662$, function: $p=0.819$, total: $p=0.984$). In comparing the patients who had recurrences, those who had more than two recurrences showed decreased range of motion ($p=0.043$). Other categories did not show statistical significance. At the last follow-up, two patients had a range of motion less than 90 degrees, which restrains their daily living. Four other patients complained of intermittent swelling and pain, though the rest of the patients did not have

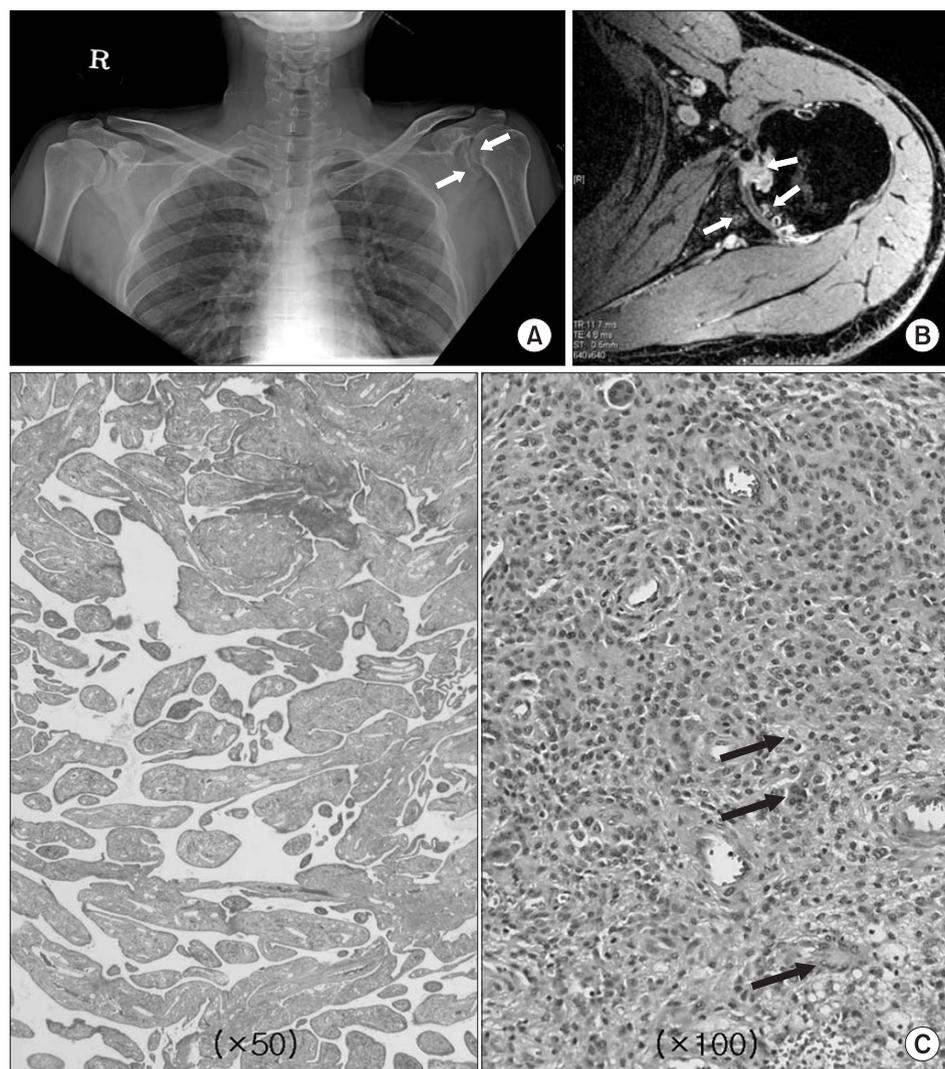


Figure 3. Representative plain radiography, MRI and Microscopic findings of diffuse-type PVNS in shoulder joint. (A) Pre-operative plain radiography presenting radiolucent lesion and bony erosions on glenohumeral joint. (B) Pre-operative MRI images (axial) presenting infiltrative diffuse mass on glenohumeral joint with bony erosion and cysts. (C) Microscopic findings present hypertrophied synovium, foam cells, giant cells which are consistent findings of PVNS (H&E stain).

Table 2. Criteria for Assessment Proposed by Ogilvie-Harris

	0	1	2	3
Pain	Severe	Moderate	Slight	None
Synovitis/swelling	Severe	Moderate	Slight	None
ROM	More than 20% loss	10% to 20% loss	0% to 10% loss	Normal
Function	Minimal activity	Reduced activity	Almost complete activity	Complete activity

Table 3. Preoperative Symptoms

Symptom	No. of patients
Palpable mass	14 (66%)
Pain	11 (52%)
Swelling	7 (33%)
LOM	2 (9%)

any complications that interfered with their living.

Discussion

Pigmented villonodular synovitis (PVNS) generally occurs in patients in the third or fourth decade of life.^{1-4,10,14} The average age of a patient in this study was 34 years, which matched the

Table 4. Result of Clinical Assessment

No	Site	Pain		Swelling		ROM		Function		Total	
		Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	Shoulder	0	3	2	2	1	2	0	2	3	9
2	Elbow	2	3	2	3	0	3	1	3	5	12
	Mean	1	3	2	2.5	0.5	2.5	0.5	2.5	4	10.5
3	Knee	0	3	1	2	2	3	1	3	4	11
4	Knee	0	2	0	1	2	2	1	2	3	7
5	Knee	0	1	2	3	1	2	2	2	5	8
6	Knee	0	3	3	3	2	2	2	3	7	11
7	Knee	3	3	3	3	2	3	3	3	11	12
8	Knee	3	3	2	3	2	3	2	3	9	12
9	Knee	1	2	2	2	2	3	2	2	7	9
10	Knee	2	3	2	3	0	1	1	2	5	9
11	Knee	1	2	3	3	2	3	2	3	8	11
12	Knee	2	2	0	2	2	1	1	1	5	6
13	Knee	0	1	1	1	1	1	1	1	3	4
14	Knee	1	2	2	1	2	3	2	3	7	9
15	Knee	3	3	2	3	2	3	2	3	9	12
16	Knee	2	2	2	2	1	1	2	2	7	7
	Mean	1.29	2.29	1.79	2.29	1.64	2.21	1.71	2.36	6.43	9.14
17	Ankle	0	2	0	1	0	2	0	1	0	6
18	Ankle	2	2	0	1	2	2	2	2	6	7
19	Ankle	1	2	2	2	0	1	0	1	3	6
20	Ankle	1	2	1	2	1	3	2	3	5	10
21	Ankle	1	1	1	2	1	1	1	1	4	5
	Mean	1	1.8	0.8	1.6	0.8	1.8	1	1.6	3.6	6.8

average age of a previous study. The knee and flexor tendon sheaths of the hand are the most frequent occurring site compare to ankle and shoulder.^{1,4-6,10,21} In this study, 66% (14 cases) occurred at the knee.

According to Myers and Masi,⁴ the distribution of PVNS by sex is close to two to one, with a predominance in male patients. Our study, however, showed a predominance of female cases, by two to one (female: 14 cases, male: 7 cases). Considering that there is also a report of the distribution being equal or opposite, a larger scale study should be done.^{4,10,14}

Palpable mass was the most common symptom at first presentation (66%); only 9% of the patients complained of limitation of motion as the initial symptom. It should be noted that if the mass locates in the popliteal fossa or ankle, it is easy to palpate. In the

previous report, swelling and pain were the common presenting symptoms.^{2,6,10}

Even though there is a hypothesis that intra-articular hemorrhage due to recurrent trauma is the cause of PVNS, many studies report that there is little connection between trauma and etiology of PVNS.^{2,4,5,10,22} In this study, there was only one patient who had a history of trauma before the initiation of symptoms.

Several authors have insisted on less extensive approaches for the treatment of diffuse PVNS, but there are reasons why an extensive approach or radical synovectomy with a safe margin has been advocated by many authors, treating PVNS like other malignancy.^{2,5-7,11,13-15,17,19,21,22} Although the pathogenesis of PVNS is still unclear, Bertoni et al.²³ reported characteristics of a malignant form PVNS in 8 cases, and Oda et al.²⁴ published

a case presenting a malignant transformation of PVNS at the sacrum, following two recurrences. These findings demonstrate that careful attention should be paid to PVNS, due to its potential for malignant behavior. Using a DNA microarray, Finis et al.²⁵⁾ described that PVNS had a decreased apoptotic cell cycle, like other malignancies. Layfield et al.²⁶⁾ found trisomies in the fifth and seventh chromosomes within tissue of PVNS. These recent findings about cytogenetic abnormalities, in the form of monoclonalities and chromosomal abnormalities, supports the malignant pathogenesis of PVNS. Addition to that, clinical findings of its local invasiveness, destruction of major joints, and frequent recurrence after the surgery have been the most concerning problems when dealing with PVNS.^{6-8,11,14,17,19,22)} Recurrence rate after surgery is reported in 8–48% of patients when diffuse-type PVNS occurs at knee.^{2,3,5,9-11)} When PVNS is in the hand, the reported recurrence rate varies from 7–45%.^{2,3,16)} There have been several reports of a low recurrence rate when arthroscopy and adjuvant radiation therapy are used, although those methods are generally considered to be appropriate for treating the localized form or biopsy.^{17,20,27)}

Due to the limitation of surgical exposure, arthroscopic removal is not suitable for diffuse-type or extra-articular type PVNS, as in the patients in this study.^{17,19)} 47% (10 cases) of the patients were referred because of recurrence after primary surgery. Among the 10 cases, 50% had previous arthroscopic removal. Considering that repeated surgery increases the chance of morbidity, such as a stiff knee, a complete resection of the pathologic mass in the initial surgery is the best method to ensure a good prognosis.

The risk that extensive open surgical approaches to the joint will increase post-operative morbidities, such as a stiff joint, or the possibility of infection, has led surgeons to hesitate before performing open procedures, which made them to try minimally invasive techniques for the resection of diffuse-type PVNS, such as arthroscopic removal.^{20,27)} Sharma et al.²²⁾ has reported satisfactory clinical outcomes with low recurrence rate, and preservation of knee joint function, after more than 6 years of follow-up using open synovectomy. Chin et al.¹⁷⁾ has also reported similar clinical outcomes after open surgery. It is thought that insufficient resection leads to recurrence, and that frequent surgery cause functional impairment of the joint. In this study, there were two patients who had a stiff knee after surgery, with a range of motion less than 90 degrees. Both of the patients had more than two re-operations, due to recurrence. The other

patients did not have functional impairment after surgery, and there was improvement in every aspect of the clinical assessment. Additionally, it was determined by telephone interview that if patients were satisfied with the surgical results, they have decreased anxiety about recurrence.

There have been reports of satisfactory results from radiation therapy as adjuvant therapy, though radiation has drawbacks.^{12,16)} There is the possibility of sarcomatous change after radiation or post-radiation fibrosis, which might obscure findings of recurrence. These changes also increase the difficulty of re-operation. Bickels et al.¹⁸⁾ reported full thickness necrosis after using the radio isotope Yttrium-90 in a patient with PVNS of the ankle joint, which led to a cessation of the use of radioisotopes for adjuvant therapy.

Although it needs demanding surgical skills to perform total synovectomy, there were satisfactory surgical outcomes without radiation therapy with the condition that complete resection with a total synovectomy.^{5,7,14,15,22)} Atmore et al.¹³⁾ and Kotwal et al.¹⁶⁾ both reported that compared to surgery alone, adjuvant radiation therapy is not advantageous. Flandry et al.¹⁵⁾ reported that it is not necessary to perform additional radiation therapy if total synovectomy is done. According to these reports, adjuvant radiation therapy should not be a routine procedure, if a surgeon performs adequate total synovectomy. We limited radiation therapy to patients with recurrence after total synovectomy, or those who had subtotal synovectomy.

We performed total synovectomy on all patients when it was possible, which resulted in all but one having total synovectomy, as for that patient it was impossible to perform total synovectomy due to anatomic reasons. Additional electrocauterization was done at the base and surrounding soft tissues instead of radiation therapy. We expected the thermal effect of electrocauterization to remove remnant pathology. During the follow-up period, of an average of 65 months, there was one (8.3%) recurrence at the knee. It was pathologically confirmed and re-operation was done, and a total of 3,000 cGy of radiation therapy was also applied. Similar to the Chin et al.¹⁷⁾ and Sharma et al.²²⁾ reports, our study shows a comparably low recurrence rate without using radiation therapy.

Considering there is no established treatment protocol for diffuse-type PVNS, our surgical outcome supports that complete total synovectomy at initial operation is the key step in successful treatment.

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미만형 색소 용모 결절성 활액막염의 관절적 활막 전 절제술 후 경과

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목적: 색소 용모 결절성 활액막염은 슬관절을 비롯한 주요 관절에서 드물게 발생하는 연부 조직 종양으로서 수술 적 치료 후 재발 빈도가 높은 것으로 알려져 있다. 본 연구에서는 주요 관절에 발생한 미만형 색소 용모 결절성 활액막염에 대한 활막 전 절제술 후 임상 경과를 보고하고, 기존에 발표 된 문헌과 비교 분석하고자 한다.

대상 및 방법: 1994년 2월부터 2006년 3월까지 미만형 색소 용모 결절성 활액막염으로 치료 받은 21예의 환자를 대상으로 하였으며, 발생 부위는 슬관절 14예, 족관절 5예, 견주관절 2예가 있었다. 평균 추시 기간은 5년 5개월이었다(36-157개월). 발생 연령은 평균 34세였으며 남자가 7명, 여자가 14명이었다. 후향적 연구 방법으로 관절 운동 범위 측정을 포함한 정기적인 임상 양상 평가를 하였다.

결과: 총 21예의 미만형 환자 중 1예를 제외 한 전례에서 활막 전 절제술 및 전기소작술을 통한 보강 치료를 시행 하였으며, 정기적인 외래 경과 관찰 상 재발이 의심 되었던 2예에서 재수술 후, 1예에서만 조직학적 재발이 확인 되었다. 활막 전 절제술을 시행 하지 못한 1예와, 재발로 재수술 받은 1예에서 술 후 방사선 치료를 시행 하였다. 임상 기능 평가상 술전과 비교하여 모든 부분에서 통계적으로 유의한 호전이 있었다($p < 0.0001$). 슬관절에 발생한 병변으로 수술적 치료를 시행 후 관절 운동 장애로 제약이 있던 환자는 2예(총 14예) 있었다.

결론: 최소 3년 이상의 추시 기간 동안 활막 전 절제술 및 전기 소작술을 통한 보강 치료로 호전된 임상 결과 및 낮은 재발율의 치료 효과를 얻을 수 있었다. 잦은 재발과 주요 관절에 발생하여 국소적 침투, 파괴로 기능 장애를 일으키는 미만형 색소 용모 결절성 활액막염에 치료에 있어 적절한 활막 전 절제술이 시행 될 경우 방사선 보강 치료는 제한 된 경우에만 필요할 것이다.

색인단어: 활액막염, 색소 용모 결절성, 활막 전 절제술

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