OPEN POSTERIOR SYNOVECTOMY FOR TREATMENT OF TENOSYNOVIAL GIANT CELL TUMORS OF THE KNEE

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Abstract-- Objective: Retrospective analysis of results from open posterior synovectomy for TGCT of knee joint

Material and method: The surgery technique includes an approach to retrocondylar space with retraction of m. gastrocnemius, posterior capsulotomy and synovectomy with direct visual control. This approach allows protection of popliteal neurovascular bundle and total neoplasm removal. The study presents 13 cases from different age groups with treatment for 4 D-TGCT and 9-N-TGCT, which localization is in posterior knee compartment. Cases are from period June 2010-December 2024

Results: Mean follow-up time in children is 13.67±1.53 months (min - 8 months) and in adults is 49.3±58.39 months (9 months-11 years). Range of motion had been fully restored for 3 months in 9 cases and for the rest - until 10th postsurgical month. There are not any repeatable monoarthritis and neoplasm relapse in 90% of cases according to control MRI . There are 2 cases with marked relapse, followed by reopetarion because of incorrect planning of primary treatment.

Conclusions: This surgical technique gives opportunity for fully removal of TGCT with intraarticular retrocondylar localization. Anatomical synovectomy is performed, while using direct visual control with opportunity for protection of poplitel artery and nerves, localized in popliteal fossa.

Key words: Tenosynovial giant cell tumor, Knee, Posterior open synovectomy

1. Introduction

Tenosynovial giant cell tumor (TGCT) is relatively uncommon when located in the posterior compartment of the knee. It is reported that the diffuse-type (D-TGCT) of

neoplasm is more prevalent than nodular-type TGCT (N-TGCT) in this area, but both forms are possible to find.[1,2] Mean age at diagnosis is 35–50 years, with low number of children cases reported.[1] Posterior compartment involvement in the knee is less common compared to anterior or suprapatellar involvement, and it presents diagnostic and therapeutic challenges.[3,5] Clasical form of treatment in symptomatic monoarthritis involves surgical synovectomy - open or arthroscopic.[1] Posterior synovectomy is considerably more challenging than the anterior approach because access is limited by nearby neurovascular and muscular structures and the procedure is performed less frequently.[4] Our own results using open synovectomy are presented in the following study.

2. Surgical Technique

A posterior longitudinal approach with a lazy-S incision in the popliteal fossa was used. After opening the crural fascia, orientation was achieved medially toward the semimembranosus and laterally toward the biceps femoris. When neoplasm is medially localized our next step is to retract m. gastrocnemius medialis next to the popliteal fossa, using it as a protection both for its own inervation/blood supply and also for the main neurovascular bundle. When neoplasm is with lateral localization the next step is a partial disinsertion of m. gastrocnemius lateralis, while protecting at the same time peroneal nerve. After opening the joint capsule, careful tumor excision with healthy synovial margins was performed. In N-TGCT the lesion has yellowish colour macroscopically, while in D-TGCT lesion has typical villous appearance. Pathologically changed synovium is removed using blunt dissection. Pigmented formation around cruciate ligaments should be removed using electrocoagulation. It is important to protect both meniscuses. Neoplasm parts with lacalization extremely near to tibial nerve and popliteal vein remain untreated. After releasnig of Esmarch is performed a careful hemostasis and closure of fibrous capsule, subcutaneus tissue and skin. (Fig.1) Diagnosis is definitely confirmed by hystological study of biopsy material from removed synovium. Postsurgical period involves wearing a hinged brace, which should be in complete extension for 15 days. After that the flection should be increased by 30° in every 15 days. Full muscle load should be performed without brace 8 weeks after surgery.

3. Materials and Methods

This technique has been utilized at the USBALO ‘Prof. B. Boychev’ clinics for managing pathological conditions with posterior intra-articular knee localization. 13 cases of hystology proven TGCT had been included in our study and in all of them had been performed the following surgery technique. Three cases are children with mean age at surgery 14.67±1.53 (between 13-15 years old) and 10 adults with mean age at surgery 36.3±9.48 (between 24-52 years old). Cases are from period June 2010-December 2024. Localization, type and duration are presented at Table 1.

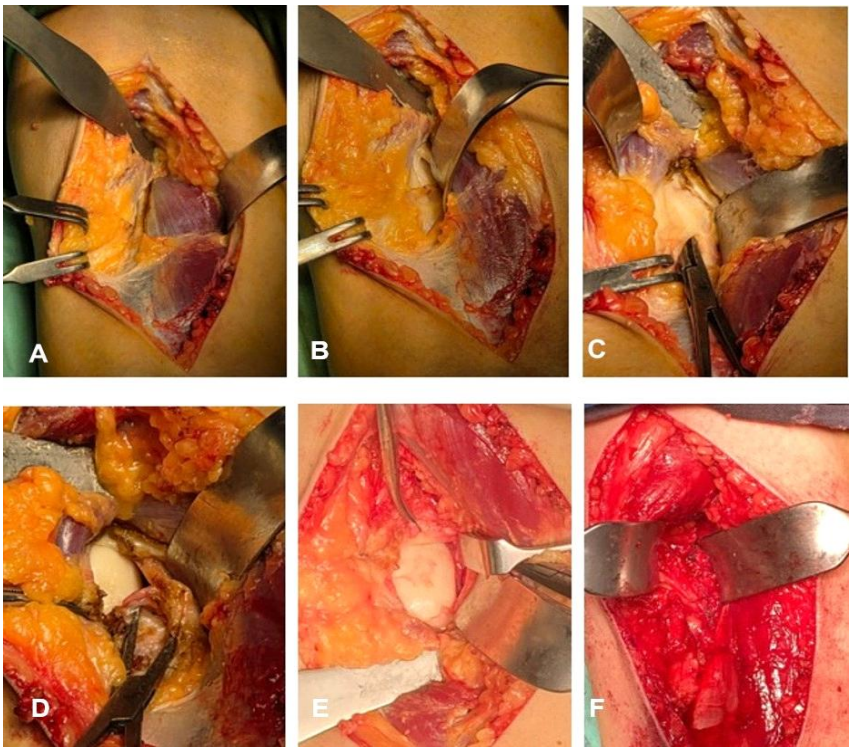

Fig. 1 Posterior synovectomy. (A and B) Medial approach between m. semimembranosus and m. gastrocnemius medialis, which is retracted laterally, using it as a protection for popliteal neurovascular bundle. At depth is presented the joint capsule. (C) Incision of fibrous capsule. (D) Removing both of pathological synovium and neoplasm with clear margins of healthy synovial tissue, using blunt dissection. (E) Joint after synovectomy, cartilage lesions of medial condyle presented - I stage Outerbridge classification.(F) Fibrous capsule closure.

	Mean age at Surgery (y)	**Sex**		**Preoperative Duration of Symptoms, (mo)**	**average.knee flexion (°)**		**D-TGCT (cases)**	**N-TGCT (cases, localization)**		**Duration of Follow-up, (mo)**	**Recurrence (cases)**
		M	**F**		**Preoper.**	**Postoper.**		**posteromedial**	**posterolateral**		
>18y 10cas.	36.3±9.48	6	4	26.1± 22.33	117.5± 19.43	128.57± 17.25	4	4	2	49.3± 58.39	2
≤18y 3cas.	14,67±1,53	1	2	5,67± 3,71	123,33± 25,17	150±0	-	3	-	13,67±1,53	0

TABLE 1. Study Group Patient information.

Clinical features in all patient include painful monoarthritis form of knee synovitis. Knee flexion was limited down to 90°-120° with presence of painfulness at flexion end-stage. There is one case with limited extension and flexion contracture of 15°.

One patient presented with limited extension and a 15° flexion contracture. Joint hydrops was observed in 11 cases. More than half of the patients (7 cases) had a delayed diagnosis of between 6 months and 2 years, with a mean delay of 12.72 ± 8.36 months. Surgical indications were based on clinical findings and MRI evaluation. We consider proton-density, fat-suppressed (PD FS) sequences to be the most informative for this assessment.

A total synovectomy was performed in 4 cases (anterior and posterior synovectomy completed in the same operative session). Subtotal synovectomy was performed in 1 case, and partial synovectomy in 8 cases. Histological analysis confirmed 8 cases as N-TGCT and 5 cases as D-TGCT. In the N-TGCT group, the neoplasm was located dorsomedially in 6 cases and dorsolaterally in 2 cases.

Clinical and MRI indicators of recurrence were reviewed annually during the first 36 months postoperatively)

For statistical analysis, Student's t-test and descriptive methods were used.

4. Results

Mean duration of follow-up in children is 13.67±1.53 months (minimum - 8 months) and in adults 49.3±58.39 months (9 months-11 years). Range of motion was complitely restored in 9 cases until 3 months and for the rest cases 10 months after surgery.

Assessment revealed cartilage changes in 5 patients (1 pediatric and 4 adult), corresponding to Outerbridge grade I.**(Fig1,E)** One additional patient demonstrated grade III changes.

Removed neoplasm is presented in most cases with size of 3/2/2 cm. In 1 case the size is 6/4/3 cm. Diagnosis in all of the cases is confirmed by hystological analysis. Cell structure in N-TGCT has a variable appearance with domination of proliferating mesenchymal cells. They have oval form, round/reniform nuclei. It could be seen small groups of larger mesenchymal cells from epitheloid type with vesicular neuclei. Between them are localized single osteoclast-like giant cells. Also there could be seen parts, containing foamy xanthoma cells with light cytoplasm and also zones, presented by fibrosis and hialinization. The formation in D-TGCT is not capsulated and is presented by diffuse infiltrative leaf-shaped model of growth with narrow, fissure-like synovial spaces. Proliferation of capillary vessels and clusters of histiocytes containing hemosiderin were observed, along with diffusely distributed foamy cells and occasional osteoclast-type giant cells.

No intraoperative or early postoperative complications were recorded. Recurrence was identified in two cases, with symptom reappearance occurring between 1 and 6 months following surgery.

In the first case, the patient had previously undergone arthroscopic synovectomy at another institution. Two months postoperatively, follow-up MRI demonstrated evidence of recurrence. A total synovectomy via combined anterior and posterior approaches was subsequently performed at USHATO "Prof. B. Boychev." This patient also exhibited the most pronounced degenerative cartilage changes, involving both femoral condyles.

The second case had initially received a histopathological diagnosis of chronic synovitis after the primary synovectomy. Owing to clinical and imaging findings suggestive of recurrence, a second intervention—subtotal posterior synovectomy via a lateral approach—was undertaken. Histological evaluation from the revision procedure confirmed nodular TGCT. In this instance, the findings indicate that the initial diagnosis was likely incorrect, representing a primary diagnostic oversight rather than a true postoperative relapse.

5. Discussion

Cases from our study confirm data for frequency, age range and diagnostic errors of knee TGCT.[1,6,7] The process duration is relevant to subchondral erosion development. For that reason we recommend MRI examination for every monoarthritis of knee joint with duration of following symptoms more than 30 days.

TGCT is a benign tumor, but it has local aggressive characteristics. That is why it is recommended surgical treatment with synovectomy and neoplasm resection. Posterior compartment synovectomy is technically harder compared to synovectomy of other part of the joint, because of the popliteal artery presence and other anatomical features.[8,9] All presented approaches ensure certain neurovascular protection under direct visual control. That is achieved with retraction of medial/lateral head of m. gastrocnemius next to the middle line. Absence of intraoperative relapses prove the protection efficacy.

We do not dismiss the potential role or outcomes of arthroscopic synovectomy in selected cases of N-TGCT via posterior portals, as this approach is associated with faster recovery and superior cosmetic results[5,8,9]. Nevertheless, we consider open synovectomy to provide a lower risk of local recurrence and to allow for more complete tumor removal when the neoplasm is located within the posterior recesses.[1,10]

Our results are with mean duration of follow-up 49.3±58.39 months and they do not deny a relapse of removed neoplasm in more than 90% of cases according to control MRI examination. (Fig 2 and Fig 3) In 11 cases, no clinical evidence of recurrent monoarthritis was detected. Postoperative outcomes were associated with a high level of patient-reported satisfaction.

We accept all relapse cases as choice of incorrect surgical method in first surgeries.

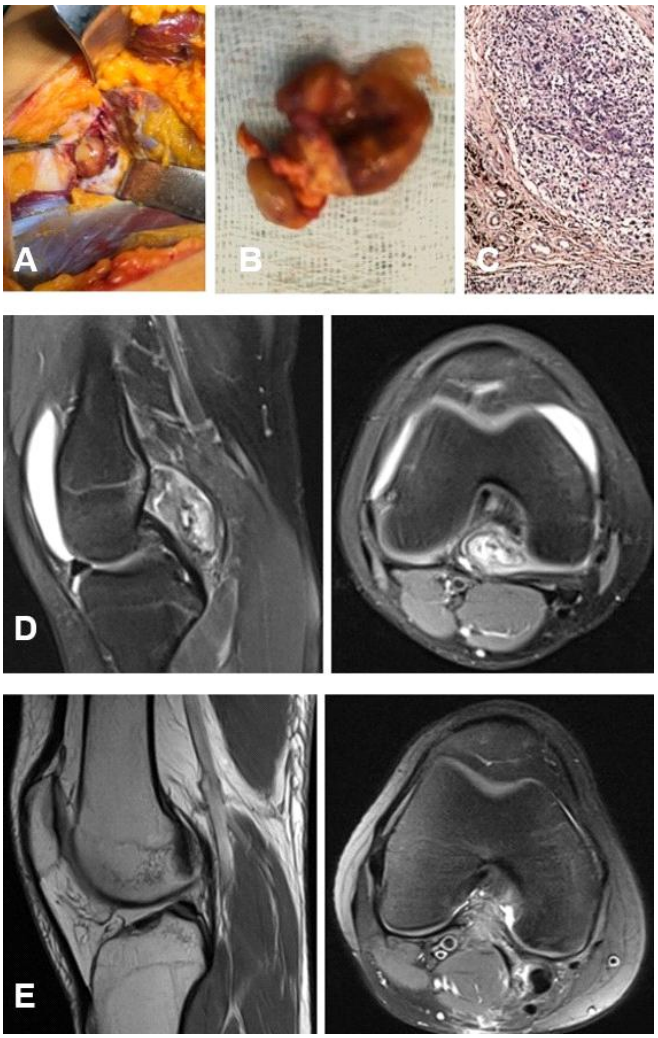

Fig. 2. Case ♀, 16y, N-TGCT.(A and B) Macroscopic view of neoplasm with size 3/2/2 cm in sito and after partial synovectomy. (C) Hystological slide, coloured by H&E, zoomed 100x. (D) Preoperative sag and ax MRI TSE PD FS - lobulated intraarticular neoplasm with medio-central localization and hydrops. (E) Postoperative 12 m. Sag and Ax MRI TSE PD FS no re-lapse data from removed neoplasm

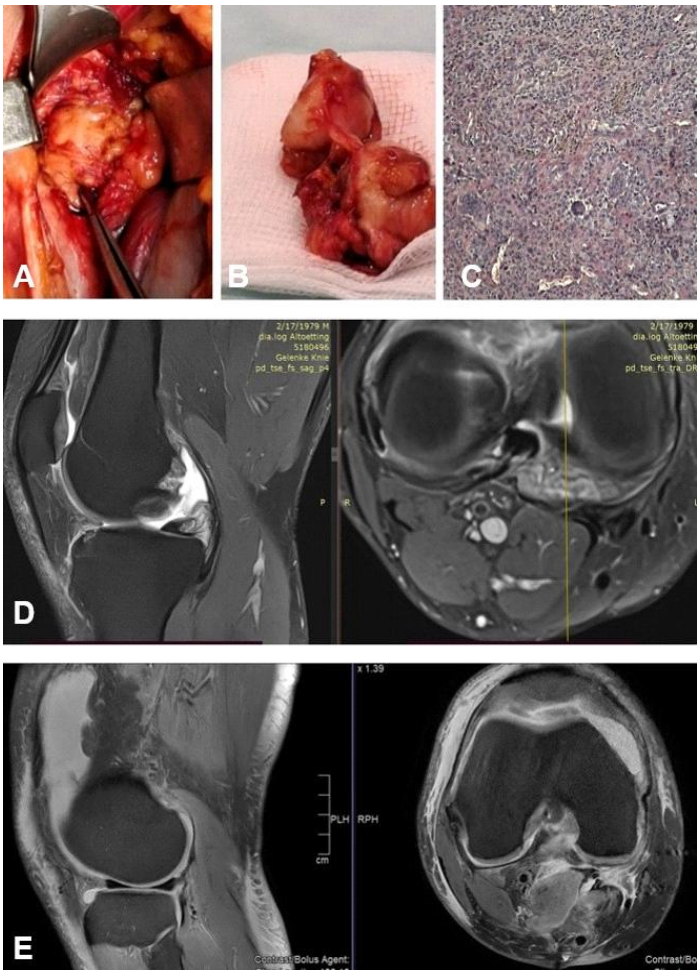

Fig. 3 Case ♂, 46y, D-TGCT. (A and B) Macroscopic neoplasm view in sito and after partial synovectomy. (C) Hystological slide, coloured by H&E, zoomed 200x. (D)Preoperative sag and ax MRI TSE PD FS. (E) Postoperative month 1. Sagittal and axial MRI (TSE PD FS) show no evidence of recurrence of the removed neoplasm. The synovectomy area is visible, with a slight hydrops in the lateral recess.

6. Conclusion

Despite our humble experience with 13 cases, we accept that this surgical technique ensures possibility for complete removal of TGCT with intraarticular retrocondylar localization. Open synovectomy is with high assurance rate, because it is performed under direct visual control and with possibility for protection for both popliteal artery and nerves.

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