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Neuroma of the infrapatellar branch of the saphenous nerve: surgical treatment technique and outcome

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The infrapatellar branch of the saphenous nerve (IPBSN) is susceptible to injury during common knee procedures, occasionally leading to the development of painful neuromas which are refractory to conservative management strategies. As a result, surgical resection has emerged as a viable treatment option for patients with persistent symptoms, and this study aims to assess the efficacy of IPBSN neuroma resection in terms of pain alleviation, functional improvement, and patient satisfaction.

A retrospective study was conducted on 40 patients who underwent IPBSN neuroma resection between 2017 and 2023. Pre- and postoperative VAS scores were collected and patients were surveyed on pain relief, functional outcomes, and satisfaction of the surgery.

The average VAS score for medial pain decreased from 6.5 ± 2.2 to 3.8 ± 2.8, and for anteromedial pain from 6.1 ± 2.6 to 3.1 ± 2.8. Overall, the majority of patients rated the outcome of the surgery positively with 73% reporting significant pain relief and 58% experiencing functional improvement postoperatively.

Surgical resection of IPBSN neuromas is a viable treatment option for patients with chronic anteromedial knee pain after previous surgeries, resulting in significant pain relief and functional improvements in a majority of challenging cases.

Keywords: Knee pain, infrapatellar branch, saphenous nerve, neuroma; post-operative.

INTRODUCTION

The infrapatellar branch of the saphenous nerve (IPBSN) is a superficial sensory nerve that supplies the anteromedial region of the knee. Given its anatomical course, it is particularly susceptible to injury during common knee procedures such as arthroscopy and total knee replacement (TKR)[1]. Damage to this nerve can result in a painful neuroma, which manifests as localized pain typically in the anteromedial region of the knee, hypersensitivity, and functional impairment[2,3]. Neuroma formation following iatrogenic injury to the IPBSN is a well-recognized but often underreported complication, leading to persistent knee pain that can substantially impact a patient's quality of life[4].

Conservative management options, such as physical therapy, local anesthetics, or corticosteroid infiltration, typically offer limited long-term relief[5]. Consequently, surgical intervention, including neuroma resection and neurolysis, has gained traction as a preferred treatment for patients whose symptoms are refractory to conservative therapies[6-8].

Despite the increasing acknowledgment of operative treatment for IPBSN neuromas, few comprehensive studies have evaluated the outcomes of surgical management. Previous studies often feature small study cohorts, limiting the generalizability of the findings[6,8]. Despite this, there is evidence that surgical excision of the neuroma can lead to meaningful improvements in pain and function. Another critical consideration for assessing the effectiveness of surgical resection is patient satisfaction to better understand the patient's perspective[8].

The goal of this study is to assess the outcomes of surgical treatment for IPBSN neuromas, focusing on pain relief, functional improvement and patient

satisfaction. By providing further data from a larger cohort, we aim to strengthen the understanding of this treatment's efficacy in patients with persistent anteromedial knee pain after previous surgery.

METHODOLOGY

We conducted a retrospective study of 52 patients who underwent surgical resection of a neuroma of the IPBSN between 2017 and 2023 in the AZ Monica Hospital in Antwerp. These patients developed painful neuromas following knee surgeries such as arthroscopy or total knee replacement. Suspicion of a IPBSN was based on localized anteromedial pain on palpation which ameliorated after administration of 2mL of marcaine 2,5mg/ml. All patients underwent extensive conservative therapy including local injection and pain clinic referral prior to this surgical treatment. All the procedures were done by the same surgeon. Patients were identified through hospital records and were contacted by phone or letter. Ethical approval for the study was obtained, and all participants provided written informed consent prior to participation.

Out of the total of 52 patients who underwent the surgical procedure, 8 patients were unresponsive and 4 did not want to participate, resulting in 40 patients that were included in the study (77%). Two questionnaires were sent to each participant for completion upon receiving written informed consent. Data and materials were obtained from the patient registration program at the Orthopaedic Centre Antwerp (ORTHOCA).

The first questionnaire is a proprietary questionnaire (Appendix 1) focused on pain relief and patient satisfaction following surgery. The knee was systematically divided into eight distinct regions to specifically assess changes in anteromedial pain, allowing for more focused analysis of pain relief (Figure 1). It included both quantitative pain scores (Visual Analogue score, scale 1-10) and qualitative feedback regarding functional improvement and satisfaction with the surgical outcome. Four subjective questions regarding satisfaction were posed. These included the final result from the patients' perspective, whether they would recommend it to a family member, whether they experience a difference in pain and lastly whether they experience a difference in function.

The second questionnaire was the validated Knee Injury and Osteoarthritis Outcome Score (KOOS) questionnaire, which is widely used to assess patient outcomes after knee surgeries. The KOOS evaluates five domains: pain, symptoms, activities of daily living (ADL), sports/recreation, and knee-related quality of life (QoL). This provided a comprehensive evaluation of the functional and quality-of-life outcomes after surgical treatment[9].

Data were analyzed using descriptive and analytical statistics. Analysis was carried out using SPSS 30.0 software (IBM Corp., Armonk, NY). The Shapiro

Fig. 1 — Systematical divisionof the knee in eight district regions to enable a more targeted analysis of pain relief by area.

Wilk test was used to assess normality of distribution. The Wilcoxon signed rank was used to compare pre- and postoperative data (VAS scores). Significance was defined as a P value <.05. Continuous variables, such as pain scores, were reported as means with standard deviations, while categorical variables, such as satisfaction, were summarized as frequencies and percentages. A reduction in the Visual Analog Scale (VAS) score was considered clinically significant if there is a decrease of at least 2 points or 30% from the baseline score. This threshold is supported by research in chronic pain management[10].

Surgical Technique

Prior to surgery, an extensive preoperative examination is crucial to precisely identify the region of maximal pain. Accurate marking of the pain area is essential for a successful outcome, as it directs the intraoperative search for the neuroma. During surgery, the previous scar is carefully reopened to minimize tissue disruption. The identification of the neuroma can be challenging due to scar tissue and anatomical variations[1]. Once the nerves are identified, sharp transection of the nerve is performed typically 3-4 cm more proximal of the skin incision under controlled traction to avoid excessive nerve damage and the proximal stump is buried in adipose tissue in order to prevent recurrence. Precise dissection and excision are critical to optimizing postoperative outcomes, with closure done carefully to minimize tension and recurrence.

The detailed pre-surgical assessment, combined with delicate and precise dissection, are key factors in the success of this technically demanding procedure. (Figure 2A and 2B).

RESULTS

In total, 40 patients were included, 6 males and 34 females with an average age of 55.6 ± 16.7 years old (Table I). The mean follow-up of patients was 37 months (range 5-80 months). The mean time interval between the last surgery and the neurectomy was 3.4 years. Patients had multiple surgeries prior to the neurectomy, with a mean of 2.7 surgeries (range 1-9). Neurectomy was performed in 14 patients after total knee arthroplasty (TKA), in 8 after revision TKA, in 6 after knee arthroscopy, in 4 after anterior cruciate ligament reconstruction, in two after unicompartimental knee arthroplasty or medial collateral ligament reconstruction or high tibial osteotomy and only once after medial patellofemoral ligament reconstruction or patellar fixation after fracture. Ten patients had further surgery after the neurectomy. A revision TKA was performed in 6 patients, in 2 patients a TKA and once a knee arthroscopy or a unicompartimental knee replacement. No peri-operative complications were noted.

The knee was subdivided in 8 subregions and the mean VAS score for each region is presented in Figure 3. Focusing on the anteromedial aspect of the knee where the IPBSN is responsible for (medial region E and inferomedial region G), the mean VAS score for region E significantly improved from 6.5 ± 2.2 preoperatively to 3.8 ± 2.8 postoperatively, resulting in a mean improvement of 2.7 ($p<0.001$). The average

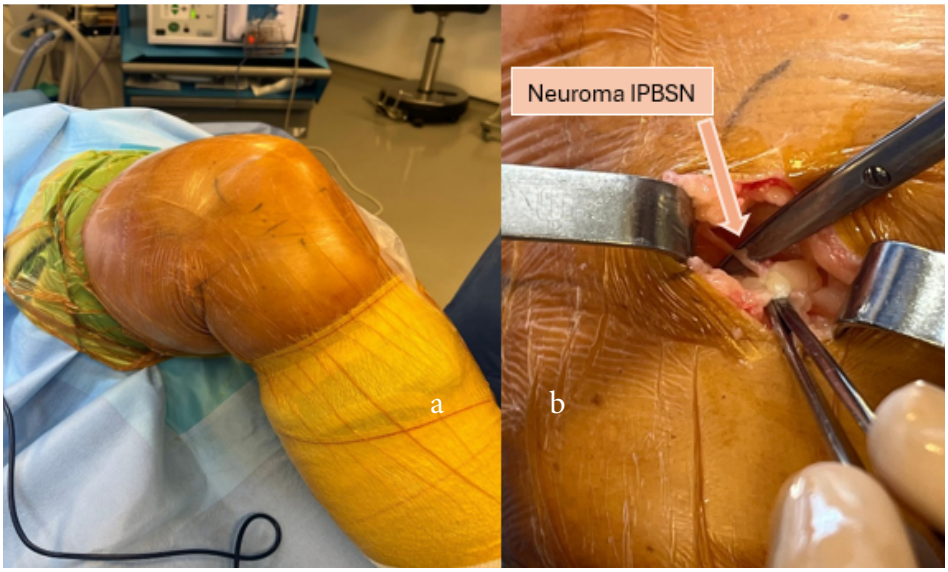

Fig. 2a-2b — a: Installation of the patient with preoperative marking while still awake. b: Neuroma of the infrapatellar branch of the saphenous nerve IPBSN.

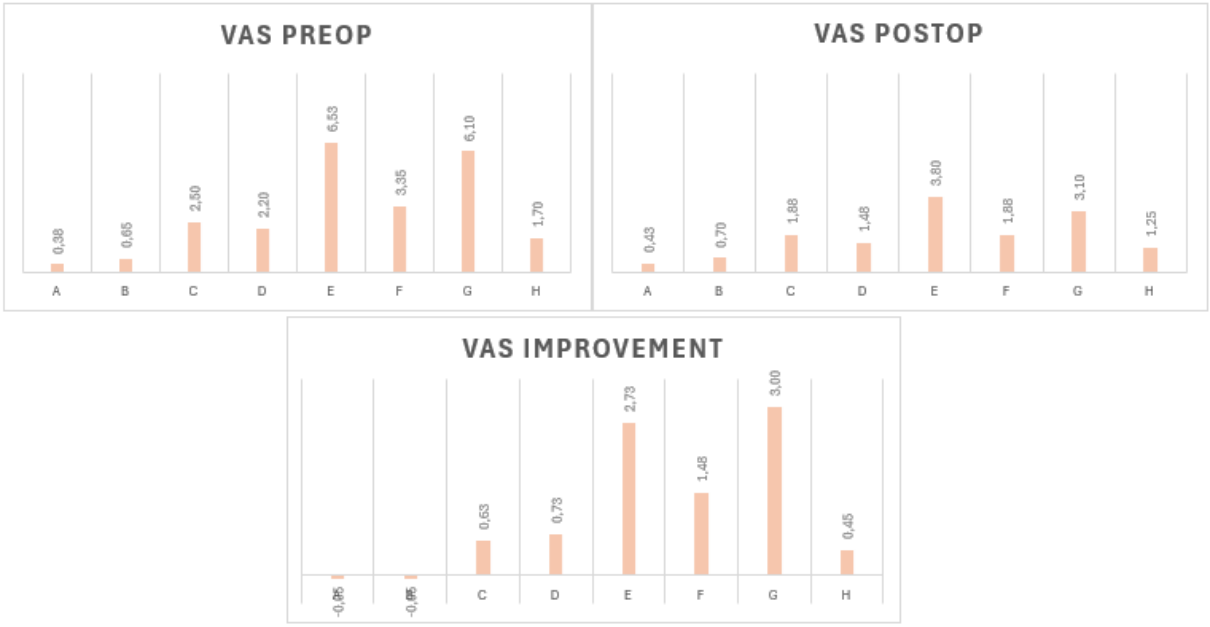

Fig. 3a,3b and 3c — VAS score for each area in the knee preoperatively (a) and postoperatively (b). The improvement of the VAS score is shown (c).

VAS score for region G significantly improved from 6.1 ± 2.6 preoperatively to 3.1 ± 2.8 postoperatively, resulting in a mean improvement of 3.0 ($p<0.001$). The study cohort was divided into responders and non-responders based on subjective pain improvement following surgery. Among the patients, 73% were classified as responders, experiencing a significant reduction in pain. In this group, the VAS score for region E improved from 6.4 ± 2.3 to 3.1 ± 2.7 (improvement of 3.3, $p < 0.001$), while region G improved from 6.2 ± 2.7 to 2.6 ± 2.7 (improvement of 3.6, $p < 0.001$). Conversely, 27% of patients were classified as non-responders, and the VAS score for region E decreased marginally from 6.7 ± 2.0 to 5.5 ± 2.5 (improvement of 1.18, $p = 0.072$), and region G decreased from 5.8 ± 2.5 to 4.5 ± 2.9 (improvement of 1.36, $p = 0.080$).

The outcomes regarding satisfaction are summarized in Table II. Overall, 53% of patients rated the surgical outcome as "Very good" or "Good," while 23% rated it negatively. Similarly, 53% of patients would recommend the surgery to a family member, while 30% would not. In terms of functional improvement, 58% rated the outcome positively compared to only 13% negatively.

The average scores for the KOOS questionnaire regarding pain, symptoms, activities of daily living (ADL), sports/recreation, and knee-related quality of life (QoL) were 65.7, 64.7, 71.2, 39.9 and 40.0 respectively.

DISCUSSION

Ihe main finding of this study is that 73% of the patients experienced a significant improvement in pain after surgical neuroma resection of the IPBSN, which supplies the anteromedial region of the knee. The VAS score improved with 3.3 for the medial region E (6.4 ± 2.3 to 3.1 ± 2.7, $p<0.001$) and 3.6 for the inferomedial region G (6.2 ± 2.7 to 2.6 ± 2.7, $p<0.001$). Secondly, 58% of the patients experienced improved functional outcomes and 53% rated the surgical result as positive. This indicates that the improvement in VAS score does not necessarily correspond with a perceived enhancement in the overall condition of the knee.

The incidence and the time it takes to develop a neuroma of the IPBSN is unclear. Shi et al. reported an incidence of 9.7% after primary TKA and 21% after revision surgery following their retrospective analysis of a single surgeon series.11 It remains a rare cause of ongoing anterior knee post-surgery and diagnosis is not clear cut. This can declare why the average time between the previous surgery and the neurectomy was 3.5 years in this study and why these patients are a particularly difficult subgroup to treat[11].

Conservative treatment by means of physical therapy, topical anaesthetic patches or infiltrations of local anaesthetics and corticosteroids remains the first line of treatment[12]. Results regarding conservative treatment remains controversial. Clenenen et al. reported satisfactory results with hydrodissection of the IPBSN from adjacent fascia followed by a

Table I. — Patients' demographics.

Patient No.	Gender	Age, yr	Height, m	Weight, kg	BMI	Number of surgeries pre-neurectomy	Last surgery pre-neurectomy	Interval last surgery to neuroma excision, mo	Follow up, mo
1	F	58	1,50	89	39,6	2	TKA	60	29
2	F	53	1,47	64	29,6	3	TKA	11	73
3	F	67	1,53	59	25,2	2	ORIF patella	153	63
4	F	53	1,58	96	38,5	2	TKA	27	42
5	F	57	1,70	80	27,7	3	HTO	15	66
6	F	67	1,63	70	26,3	4	TKA	83	21
7	F	61	1,60	73	28,5	5	TKA	37	37
8	F	63	1,58	76	30,4	1	TKA	13	20
9	F	54	1,68	69	24,4	4	Arthroscopy	54	38
10	F	68	1,64	82	30,5	1	UKA	28	30
11	F	70	1,60	73	28,5	3	Revision TKA	80	47
12	F	74	1,72	75	25,4	1	TKA	26	11
13	F	72	1,53	70	29,9	2	TKA	9	7
14	M	53	1,82	85	25,7	1	MCL reconstruction	24	74
15	F	32	1,60	63	24,6	3	ACL reconstruction	62	42
16	F	44	1,67	74	26,5	9	HTO	23	35
17	F	24	1,70	79	27,3	2	MPFL reconstruction	34	25
18	F	70	1,62	72	27,4	2	Revision TKA	30	20
19	F	19	1,67	53	19,0	1	MCL reconstruction	3	23
20	F	76				1	TKA	142	20
21	F	23				7	Arthroscopy: revision meniscal transplant	98	5
22	M	61	1,82	115	34,7	2	TKA	34	9
23	F	53	1,78	59	18,6	7	TKA	16	11
24	M	56	1,84	110	32,5	2	Revision TKA	76	41
25	F	39	1,76	52	16,8	3	Arthroscopy: meniscal transplant	5	80
26	F	80				1	TKA	12	46
27	F	52	1,61	73	28,2	5	Revision TKA	94	29
28	F	50	1,65	71	26,1	2	ACL reconstruction	27	28
29	F	56	1,66	65	23,6	1	Arthroscopy	81	21
30	M	40	1,92	100	27,1	1	ACL reconstruction	22	28
31	M	49	1,70	80	27,7	2	Arthroscopy	32	36
32	F	40	1,77	80	25,5	2	Arthoscopy: meniscal transplant	6	28
33	F	60	1,64	68	25,3	1	TKA	11	65
34	F	80	1,68	58	20,5	2	TKA	15	66
35	M	65	1,87	91	26,0	3	Revision TKA	46	48
36	F	73	1,67	61	21,9	2	Revision TKA	51	48
37	F	79	1,58	54	21,6	3	Revision TKA	13	72
38	F	56	1,71	56	19,2	2	UKA	8	41
39	F	20	1,73	52	17,4	1	ACL reconstruction	33	39
40	F	51				6	Revision TKA	72	6
Mean ± SD		55,5 ± 16,3	1,67 ± 0,1	73,5 ± 15,5	26,3 ± 5,2	2,7 ± 1,9		41,7 ± 36,2	36,8 ± 20,6

F: Female; M: male; BMI: Body mass index; TKA: Total knee arthroplasty; UKA: Unicondylar knee arthroplasty; HTO: High tibial osteotomy; ACL: Anterior cruciate ligament; MPFL: Medial patellofemoral ligament.

cortisone infiltration in 9 out of 16 patients whereas Shi et al. were unable to elicit prolonged pain relief in 83% of 105 patients by means of local infiltrations[11,13].

The results of this study demonstrate that surgical resection of the IPBSN is a viable treatment option for patients suffering from chronic anteromedial knee pain after previous surgery who were refractory to conservative treatment. A significant reduction in VAS pain scores in the anteromedial area observed in our patient cohort confirms the efficacy of this procedure. A majority of patients rated their surgical outcomes as "Very good" or "Good," and 73% reported significant pain relief. Chalidis et al. reported an almost complete immediate pain relief and improvement in knee range

Table II. — Four subjective questions regarding satisfaction were posed, to summarize the final result from the patients' perspective.

	Result	Recommend	Effect on function	Effect on pain
Very good	20%	20%	30%	43%
Good	33%	33%	28%	30%
Neutral	25%	18%	30%	15%
Poor	18%	18%	10%	10%
Very poor	5%	13%	3%	3%

of motion in all of their 15 patients after surgical neuroma excision and described a technique with a separate oblique medial skin incision following the course of IPBSN[14]. A similar study was performed by Giannetti et al. who performed a surgical neuroma excision of the IPBSN in 13 patients, resulting in an improvement of the average pain score from 7.6 to 3.4 postoperatively[15]. The largest cohort till date is the study of Shi et al. with a study population of 50 cases and they also describe a surgical technique by a separate vertical medial/lateral incision. They found a positive effect on pain relief in 84% of their patients with a reduction in VAS score from 9.4 to 1.1 postoperatively and with a follow-up duration of 24 months[11]. Our findings are consistent with previous studies and this suggests that neuroma resection can lead to meaningful improvements in not only pain, but also in function. This further highlights the impact this procedure can have on overall quality of life and reinforces the role of surgical intervention in managing refractory cases.

This study has several limitations. First, the absence of recorded preoperative KOOS scores, which makes it difficult to quantify the exact degree of overall clinical improvement following surgery. However, the postoperative KOOS scores recorded in this study provide valuable insights into the challenges faced by this patient population. The moderate scores in domains such as pain (65.7) and symptoms (64.7), along with the notably low scores in sports/recreation (39.9) and quality of life (40.0), reflect the significant impact of prior knee surgeries and chronic pain on these individuals. This suggests that the patient group represents a particularly difficult population to treat, given their history of persistent symptoms and functional limitations despite surgical intervention. Secondly it does not include a control group due to the retrospective observational nature of this study. Thirdly, the procedures were performed by a single surgeon.

While the body of literature is still relatively limited, our study of 40 patients represents one of the larger cohorts published to date with a mean follow-up of 37 months. We describe a technique by using the same incision as the previous surgery instead of using a separate incision. By dividing the knee in 8 separate areas we achieve a more targeted analysis of pain relief. All this contributes to the growing understanding of this condition and providing further evidence that operative treatment can significantly enhance patient quality of life. The reduction in chronic knee pain observed in our patient group underscores the importance of considering surgical treatment for refractory cases, particularly when conservative therapies have failed. Future research should continue to explore the long-term outcomes and refine patient selection criteria to identify the responders to maximize the success of surgical interventions for IPBSN neuromas.

In conclusion, surgical resection of IPBSN neuromas is a viable treatment option for patients with chronic anteromedial knee pain after previous surgeries, resulting in significant pain relief and functional improvements in a majority of challenging cases.

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