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Retrospective Study on the Use of Hemostatic Tape during Total Knee Arthroplasty Surgery

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Abstract: Due to the increased incidence and prevalence rate, knee arthrosis is more significant than other categories of arthrosis, primarily affecting young obese women. The use of a surgical tourniquet can result in both arterial and venous stasis in the lower leg during the swelling period. This potential consequence may increase the risk of postoperative venous thromboembolism. A prospective observational study was conducted, which included 730 patients diagnosed with gonarthrosis. Demographic data, risk factors, clinical assessments, type of intervention, type of implant used, treatment administered, benefits obtained, complications recorded, and quality of life were collected for the entire patient group and for each study year individually. Both reduced complications related to the prosthesis and immediate and 6-month benefits were statistically significantly better in patients without hemostatic tape compared to those with hemostatic tape. The advantages of this approach include the potential for a faster recovery with improved long-term mobility and the ability to effectively compare the results obtained. Therefore, this paper provides a robust and informative database with a strong focus on the mentioned subject, which is useful for medical professionals and individuals interested in the topic.
Keywords: Knee arthroplasty, hemostatic tapes, gonarthrosis, surgical interventions

1. Introduction: Arthrosis of the knee joint, also known as gonarthrosis, causes considerable functional disability and disability, becoming an important problem for the health of the population, with high costs in the social and economic sectors [1]. Due to the aging of the population, osteoarthritis affects up to 30% of people over 65 (10% of men and 17% of women over 65 are affected) and is among the 4 main causes of morbidity, being the most frequent cause of knee pain after the age of 50, as an effect of obesity [2]. Due to the increased incidence and prevalence rate, knee arthrosis is more significant than other categories of arthrosis, mainly affecting young obese women [3]. Various authors have indicated that the average age of patients undergoing ATG is decreasing and the proportion of subjects under 65 is increasing [4]. For orthopedic surgeons, young subjects represent difficult tasks due to the fact that they assume that the activity rate will increase after surgery and also because their life expectancy is longer [4]. For patients in their 50s, the excitement over an implant with a survival time of 5-10 years is greater than for those in their 30s. Because younger patients are more active, the implant is under increased pressure, which increases the likelihood of corrective surgery. Therefore, total knee replacement must provide optimal function, durability, and protect the bone as best as possible [5-7].

A tourniquet is an occlusive device that restricts distal blood flow to help create a blood-free field during the procedure. A tourniquet may be associated with an increased risk of pain and complications. The use of a tourniquet can improve the surgical field of view by limiting

intraoperative blood loss [8]. To maintain and fix the ATG components in the correct position on the bone, most of them are cemented in place. The cement, which is initially soft when inserted, interdigitates in the porous bone, forming a strong bond as it hardens. Some surgeons believe that the use of a tourniquet helps reduce bleeding from porous bone ends and facilitates more effective adhesion of soft cement, thereby improving the long-term survival of knee implant components. One of the reported benefits is reduced intraoperative blood loss when a tourniquet was used [9]. The use of a surgical tourniquet can cause both arterial and venous stasis in the lower leg during the swelling period (usually over an hour). This may potentially increase the risk of postoperative venous thromboembolism [8].

There is a risk that systemic emboli are not the only thromboembolic risk associated with tourniquet use [10-12]. After tourniquet deflation, systemic emboli can occur. Transesophageal echocardiography demonstrated the presence of shower-like echogenic materials circulating from the lower limbs to the right atrium, ventricle, and pulmonary artery after the release of a tourniquet applied to the thigh. Macroscopic emboli in the central circulation have also been observed. Because the carotid arteries are the first branches of the aortic arch, these clots can enter the cerebral circulation. Transcranial Doppler ultrasound studies have shown that echogenic material is present in approximately 60% of cases in the circle of Willis after tourniquet release and revealed that microemboli can occur even in the absence of a patent foramen ovale (a connection between the left and right sides of the heart circulation). The most likely route for emboli in these circumstances is through the pulmonary capillaries or the opening of other pulmonary vessels. The critical moment is immediately after tourniquet release when there is potential hemodynamic instability and evidence suggesting a fivefold increase in the amount of embolic material [13].

The pursued objectives are as follows:

Follow-up of the healing process of patients without anti-inflammatory treatment in the first 7 postoperative days compared to those treated with non-steroidal anti-inflammatory drugs.

Establishing a new surgical technique by removing the hemostatic band in patients with pre-existing associated diseases to reduce the occurrence of ischemic complications and soft tissue injuries.

2. General Materials and Methods

2.1. Study Design

A prospective observational study was carried out, including 730 patients diagnosed with gonarthrosis, consecutively recruited from the orthopedics department of the Oradea Emergency County Clinical Hospital in Oradea, Romania, during the period 2018-2022 (ethics commission approval no. 14146/15.06.2018).

Demographic data, risk factors, clinical assessments, type of intervention, type of implant used, treatment administered, benefits obtained, complications recorded, and quality of life were collected for the entire patient group and separately for each study year.

2.2. Clinical Analysis

The study followed risk factors, clinical evaluation, surgical approach, complications, applied treatments, and benefits according to the type of intervention. Post-operative evaluations were conducted at 2 weeks, 6 weeks, 3 months, and 6 months.

Clinical parameters were categorized into two groups: risk factors contributing to the development of knee arthropathies and specific clinical evaluations.

2.3. Statistical Analysis:

Statistical data analysis was performed using SPSS 20 software (New York, USA). One-way ANOVA was used to determine statistical differences in surface roughness, hardness, and tensile parameters among the three types of resins used, while Chi-square was employed for non-parametric statistical analysis. Skewness and Kurtosis statistical tests were conducted, and the Bonferroni multiple comparison test was used to identify statistically significant differences between possible paired samples. The significance level for statistical analysis was set at $p < 0.05$.

2.4. Research Methodology

The study monitored the progress of 713 patients who underwent total knee arthroplasty using the cemented technique, depending on the use of hemostatic tape during the surgical intervention. Study parameters included prosthesis complications, immediate benefits, and benefits at 6 months.

- ***Inclusion Criteria:***

Minimum age of 18 years.
Signing of the informed consent agreement.
Advanced knee arthropathy with or without previous surgery.

- ***Exclusion Criteria:***

Lack of informed consent.
The presence of serious neurological problems.
Existence of severe comorbidities.
Any condition that could have compromised patient monitoring.

3. Results

Out of the total of 713 patients, the majority did not use a hemostatic band, accounting for 76.0% (542 patients). Only 24% (171 patients) used a band from the years 2018 and 2019, including 86 men and 85 women.

Among the complications of the prosthesis, we observed the range of motion of the knee (ROM) and patellar clunk syndrome. Figure 1 shows that there were more cases without any complications in the group without anti-inflammatories. Greater than 90° range of motion was more frequently recorded in the NSAID group, while patellar clunk syndrome was observed in the N-NSAIDs group. The large standard deviation in the group with hemostatic tape and patellar clunk syndrome indicates that patients were from both the N-NSAIDs and NSAID groups. Conversely, the lack of standard deviation in the group with hemostatic tape and the complication of ROM < 90° indicates that the patients belong exclusively to the NSAID group. Significant differences ($p < 0.01$) were observed between the groups without and with the hemostatic band in each of the prosthesis complications.

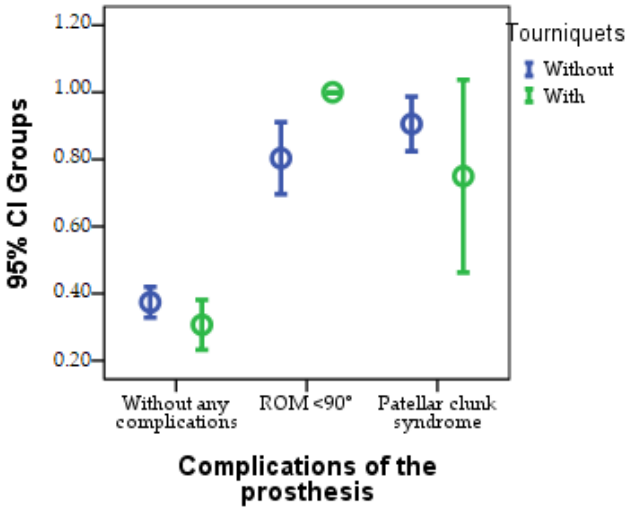

Figure 1: Complications of the prosthesis by batch following the application of hemostatic tape.

ATG interventions with tourniquets are likely to be somewhat less beneficial and associated with higher risks than surgery without tourniquets. This can also be observed in the case of the study described in Table 1, where immediate benefits such as reduced stiffness, low local sensitivity, physiological hyperextension, improved mobility, hyperextension without deficits, increased range of motion, leg flexion of 110-115 degrees, and joint stability were noted. There was a statistically significant difference between the two groups, with significantly more immediate benefits observed.

Regarding benefits at 6 months, significantly greater improvements were observed in the group without hemostatic tape in terms of resuming daily activities at 6 weeks, returning to pre-osteoarthritis activities at 6 months, climbing and descending without crutches at 3 months, and experiencing diminished or absent nocturnal pain at 3 months (see Table 1).

Table 1: Follow-up of immediate and 6-month benefits based on the use of hemostatic tape and statistical significance.

Parameters		Tourniquets				p
		Without		With		
		N	%	N	%	
Immediate benefits	Lack of rigidity	16	2.2	1	0.1	0.001
	Low local sensitivity	8	1.1	3	0.4	0.024
	Physiological hyperextension	66	9.3	26	3.6	0.001
	Regaining mobility	67	9.4	27	3.8	0.001
	Hyperextension without deficits	53	7.4	14	2.0	0.001
	Amplitude of movement	59	8.3	20	2.8	0.001
	Leg flexion of 110-115 degrees	84	11.8	24	3.4	0.001
	Joint stability	31	4.3	10	1.4	0.001
Benefits at 6 months	Resumption of daily activities at 6 weeks	69	9.7	27	3.8	0.001
	Return to pre-arthrosis activities at 6 months	267	37.4	81	11.4	0.001
	Climbing up and down without crutches at 3 months	64	9.0	20	2.8	0.001
	Nocturnal pain diminished or absent at 3 months	110	15.4	34	4.8	0.001

When examining the distribution of immediate benefits based on the groups, it becomes evident that the absence of stiffness was exclusively observed in patients with hemostatic tape in the NSAID group. With the exception of joint stability, where more patients with tape belonged to the NSAID group, the remaining benefits showed a higher occurrence in patients without hemostatic tape in the N-NSAIDs group. This observation is illustrated in Figure 2.

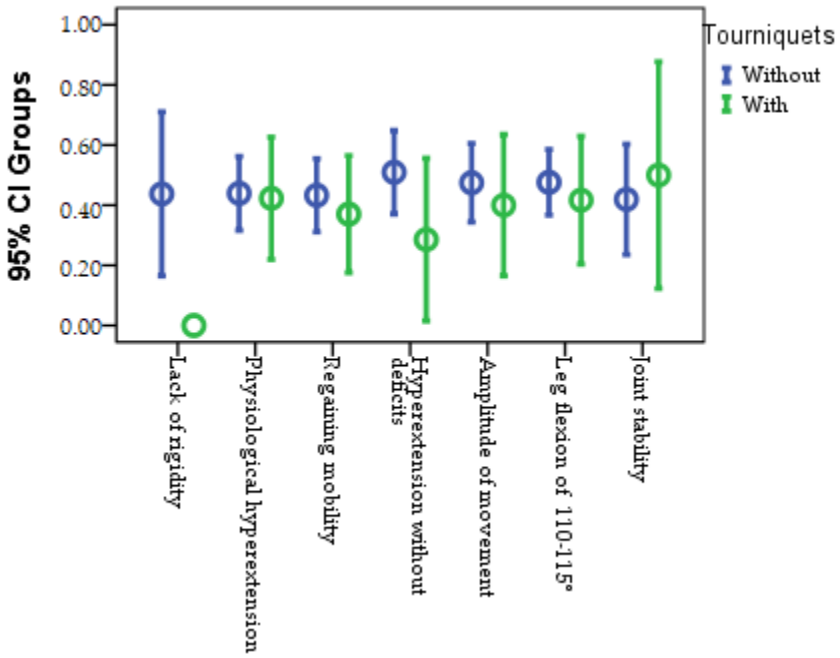

Figure 2: Immediate benefits with tourniquets in each batch.

Regarding the distribution of benefits at 6 months based on the groups, it is evident that for each benefit, a greater number of patients from the group without hemostatic tape were in the N-NSAIDs group, as illustrated in Figure 3.

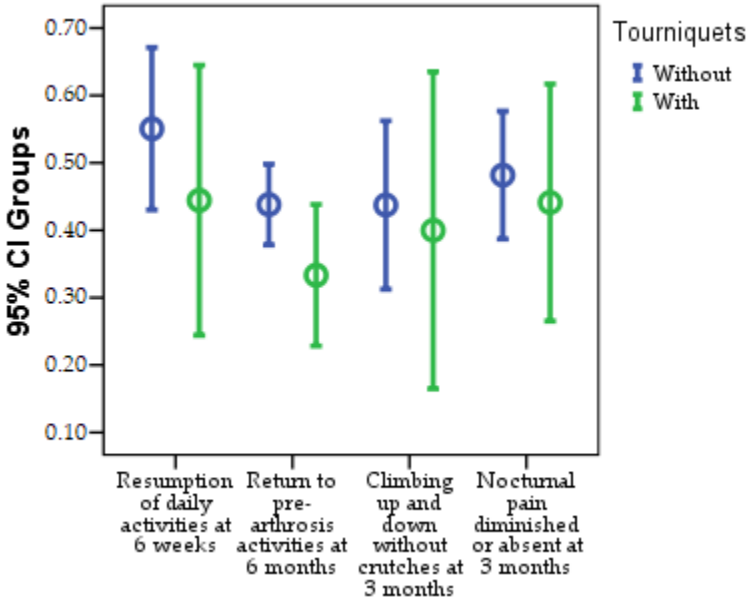

Figure 3: Benefits at 6 months with tourniquets in each group.

4. Discussions

Studies have indicated that surgery with a tourniquet may be associated with a higher risk of serious adverse events compared to surgery without a tourniquet. This evidence was downgraded due to the risk of bias. The serious adverse events included in the studies were deep vein thrombosis, pulmonary embolism, infection, and reoperations, with the exception of implant loosening [10].

In the present study, it was found that the knee flexion position, without the use of a tourniquet, resulted in regaining mobility, better range of motion (ROM) function, and a lack of lower limb stiffness in the early stage of rehabilitation.

These beneficial effects in the knee flexion position without a tourniquet are attributed to the fact that tourniquet use can directly compress soft tissues, causing soft tissue damage and inducing pain, which may hinder postoperative functional exercises and patient recovery. Additionally, in patients who have used a tourniquet, increased hidden blood loss can lead to swelling of the limbs in the soft tissues, resulting in thigh pain. Furthermore, knee swelling can increase tension in the soft tissues and limit the patient's early functional recovery after surgery [12,14,15].

Previous studies by Mizner et al [16] and Yoshida et al [17] suggested that quadriceps femoris strength in patients undergoing total knee replacement (TKA) is one of the strongest predictors of long-term function, including walking skills, stair climbing, and chair lifting. Similar results were reported by Dennis et al [14], who concluded that patients who underwent TKA and used a tourniquet showed a decrease in quadriceps strength during the first 3 months after surgery. Therefore, the use of a tourniquet may have a negative impact on early improvement in muscle strength and lower extremity function in knee replacement.

Surgery with a tourniquet was significantly associated with a higher risk of deep vein thrombosis and infection compared to surgery without a tourniquet. However, no significant association was found between tourniquet surgery and the risk of pulmonary embolism or reoperation compared to non-tourniquet surgery [8,9,14,18].

Evidence suggests an uncertain effect of tourniquet surgery on the risk of revision surgery compared to non-tourniquet surgery. This uncertainty is due to a serious risk of bias and imprecision, as well as the low number of revision surgeries in both study groups over two years. Data on cognitive function were not extracted from the studies [19-22].

Nonetheless, non-significant differences between patients operated with and without a tourniquet in the long term were published [11], However, this study was published in 2017, when the patients in this study were also operated on with a hemostatic band. Nevertheless, after 2020, when the side effects of COVID-19 at the vascular level were already known, the intervention without a tourniquet was preferred to reduce the risks [23]. Thus, it became possible to compare the two groups, and it was found that both the complications of the prosthesis are reduced and the benefits are more pronounced, statistically significantly, in patients operated without a hemostatic band.

4. Conclusions:

Both the reduced complications of the prosthesis and the immediate and 6-month benefits were statistically significantly better in patients without a hemostatic tape compared to those with a hemostatic tape.

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