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CLINICAL EXPERIENCE USING THE POLYPROPYLENE MESH FOR THE PREVENTION OF HIP ARTHROPLASTY DISLOCATION

Abstract. Formulation of the problem Dislocation of the femoral component of the endoprosthesis is one of the most frequent complication of total hip replacement. One of the method preventing this complication is a proper restoration of soft tissue and capsule structures. In this paper, we propose a method for restoring and strengthening the posterior structures of the capsule of the hip joint using polypropylene mesh. The purpose of this study is to improve patient outcomes by strengthening the hip joint capsule and closing it with the polypropylene mesh and to study the expectation of THA dislocation in such cases.

Results The results showed that HHS total points were better in the study group than control one after 12 months as well as after 24 months post-OP. The static-dynamic function of the operated limb in patients whose capsule defect was closed with PM was higher than the corresponding parameters of the control group, which corresponded to 42.86±3.01 points after one year after surgery. According to the findings, the risk of hip arthroplasty dislocation in patients undergoing posterior strengthening of the capsule joint with the PM was significantly less than in the control group. The proportion of patients in whom this complication may not develop in the main group was 82.4%, which is better than in the control group - 64.9% by 17.5%.

Conclusions Strengthening of the hip joint soft tissue structures using PM leads to better prognostic results of primary and revision surgery and reduces the risk of dislocation after arthroplasty

Keywords: endoprosthesis, hip joint, dislocation, polypropylene, total hip arthroplasty

Background

Among all complications of total hip arthroplasty (THA), dislocations is on the second place, by

frequency of causes the revision surgery, after aseptic loosening of components. Therefore, the treatment of patients with this complication is an urgent and

complex problem of modern traumatology, which requires a systematic and thorough study.

According to numerous data, the incidence of dislocation after primary THA varies from 0.5 to 2% [1]. Relapses after primary dislocation and closed management occur in 16-59% of patients [2]. It should be noted that after revision surgeries, the number of recurrent dislocations has increased by almost ten times compared to primary arthroplasty [3]. According Gaiko et al., dislocations of the hip arthroplasty after revision surgery in the postoperative period are observed in 4% of cases, mainly in the period up to 3 months [4].

Currently, to improve surgical technique, a lot of research work performs and some authors reporting success in reducing the incidence of dislocation (by 10%) in case of primary arthroplasty, but the percentage of dislocation after revision is still high, up to 28% [5].

It should be noted that the etiology of dislocation are often multifactorial, but there is always exist one, leading reason that led to the development of this complication. The global community of orthopedists divides the etiologic factors of the THA dislocation into three groups, which include: patient-relative factors, factors related to surgical technique, implant- relative factors [6].

Surgical technique is a rather debatable issue in the development of post-OP dislocation. However, since 75-90% of dislocations occur in the posterior direction [7], surgical approach that compromises the posterior soft tissue structures theoretically contributes to instability. Many authors argue that the careful restoration of the hip joint soft tissue structures or their preservation through modified approaches significantly reduces the frequency of dislocation. It has been estimated that posterior approach without soft tissue restoration has 8.21 times greater risk of dislocation than with the same approach, but with the restoration of capsule structures [8].

Many authors confirm the need of careful restoration of the posterior capsule structures to the maximum extent possible, both during primary and revision surgery, to maximize the stability of all endoprosthesis components. The direct correlation of the stability of the hip endoprosthesis with the thickness of the capsule is proved. For the thinnest capsule – 1mm, peak dislocation resistance reaches only 53% of the capsule having a thickness of 3.5mm and only 31% of the maximum capsule thickness of 6mm [9] (Fig. 1).

Fig.1. Resisting moment developed during hip flexion versus capsule thickness. Insert curves are reprinted from the data of Dihlmann et al [9]

It should be noted that a single strengthening and restoration of the posterior capsule structures is not enough to prevent the dislocation, a prerequisite is the correct placement of the endoprosthesis components, as well as a doctor's strategy of the patient management.

Capsule insertion defects, along either the acetabular or the femoral attachments, involved decreases in dislocation energy dissipation of more than 50% relative to intact-capsule levels. Repairs of

such defects returned peak resisting moment values to within 10-20% of baseline levels. [8].

In order to strengthen the hip joint capsular structures, we have proposed a method of a polypropylene mesh implantation closing capsule defect, with its subsequent sewing to the surrounding soft tissues [10, 11].

The aim of this study was to improve patient outcomes by strengthening the hip joint capsule and closing it with the polypropylene mesh (PM) and to study the expectation of THA dislocation in such cases.

Methods

Study design and patients. A retrospective study of case histories, radiographs and laboratory findings of 47 patients requiring recovery or strengthening the hip joint capsule was performed; primary THA was performed in 26 patients (55.3%), revision surgery in 21 cases (44.7%). Table 1 presents the characteristics of the patients

Table 1

All 26 patients who underwent primary THA had a limb shortening of 2 to 8 cm, requiring capsulotomy and capspectomy when mobilizing the hip joint during surgery.

The patients were divided into 2 groups: the study group (n = 24), in which during the arthroplasty was used the proposed method of strengthening the capsule-ligament apparatus taking into account the state of the capsule and surrounding joints soft tissues and the control group (n = 23), in which, after the installation of all components of the endoprosthesis, the classic layer-by-layer suturing of the capsule and soft tissues was performed in a stretched way in order to close the elements of the endoprosthesis and restore the soft tissue structures. The proposed method is center around the polypropylene mesh placed on top of the sutured capsule while the edges of the mesh go 30mm in both directions from the place of fixation of the capsule to the tendons in case of absence of a capsule defect. External rotators, ligaments and tendon are fixed to the mesh in free order, with the mesh being fixed around the perimeter, through the entire thickness of the capsule and tendon. In the case of a significant capsule defect - after the installation of all components of the endoprosthesis, in the projection of the capsule defect on the fibrous surface impose a polypropylene mesh, with one edge sewn to the free edge of the capsule, and the other one to the tendons and soft tissues remaining on the femur bone so that the capsule comes over the edge of the mesh at least 20mm, with the mesh fixed around the perimeter, through the entire thickness of the capsule

Data collection. For the purpose of examination and further evaluation of treatment results, we used clinical examination, objective and subjective evaluation of joint function, questioning of patients on cases of dislocation in postoperative period. Evaluation of treatment results was performed in both groups in dynamics: after 12 and 24 months post-OP. For the objective evaluation of hip joint function, the Harris Hip Score was used, in which the main criteria are pain, function, limb resistance, deformity and range of

motions. The results considered unsatisfactory if the total score ≤ 70 points; 71-80 is satisfactory, 81-90 is well and 91-100 is excellent. Statistical processing of the obtained quantitative and qualitative indicators was carried out with the help of the software package Statistica 13.0. In order to predict the probability of dislocation a Kaplan-Meier survival analysis was performed.

Results and Discussion

In both groups in 12 and 24 months after surgery, excellent treatment results prevailed. It should be noted that in the study group one year after THA, the number of patients with excellent results was higher than the control group by 1.25 times, a similar trend was observed after 24 months and was 1.12 times better (Fig. 2)

Fig.2 The allocation of patients in both groups by the total Harris Hip Score

The number of patients who entered the categories of satisfactory and well results significantly differed in both groups during all study terms. The most significant differences between the groups were observed after 12 months, so in the study group 34.7% of patients received well and satisfactory results, in the control group the number of patients of these categories was higher by 13.1% and amounted to 47.8%. In 2 years after THA, the number of patients who had satisfactory and well results of treatment by HHS decreased significantly and arrive at 8.7% in study group and 19% in control group, which is higher in 2.2 times. During the research work, no one of the patient received an unsatisfactory result by HHS.

The results showed that HHS total points were better in the study group than control one after 12 months as well as after 24 months post-OP, however, they were out of statistical control due to the small number of observations. The static-dynamic function of the operated limb in patients whose capsule defect was closed with PM was higher than the corresponding parameters of the control group, which corresponded to 42.86 ± 3.01 points in one year after surgery. After 2 years of the postoperative period, the static-dynamic function of the limb did not differ significantly in both groups. Among the criteria in which patients lost more points were: during the first year post-OP patients of study and control group complain of the ambulation with support – 45.8% and 46.8%, respectively, in addition, patients reported difficulty using the stairs (had to use banister), 29.2% and 30.4%, respectively. Lameness and limitation of walking distance were also limiting factors in both groups. 2 years after surgery, there were isolated cases of functionality limitation, mainly due to the need to use support for long walks and to use the banister. The obtained results can be interpreted as satisfactory, especially given the fact that, in certain cases, the recurrence of dislocation was diagnosed during the first year of the postoperative period, which required either conservative or re-operative treatment.

Thus, the difference in the dynamics of hip joint function recovery after THA is especially noticeable in the first year after surgery, which, in turn, come to the

fore importance for improving the quality of life and minimizing the consequences of surgical treatment, providing a more favorable functional result.

Table 2 shows that in each period, the data indicating the severity of pain was higher in the control group than in the study group. Thus, in a survey of patients from the control group, it was found that one year after surgery, 9 (42.8%) cases showed mild, occasional pain, which did not affect activity, and in 5 (23.8) cases, the pain became moderate in physical activity requiring medical treatment, in study group these indicators were higher and amounted to 12 (52.2%) and 5 (21.7%) respectively.

Table 2

The severity of pain in patients of the study group during the first year after surgery may be associated with the chronicity of the inflammatory process around the mesh implant and the possible mechanical effects on nerve fibers. In a more distant period, mild pain was maintained in 9 (39.1%) cases of the main group and 7 (33.3%) cases of the control group. Take into account that the indication for apply PM was a change in length of the limb (elongation of more than 2 cm) pain is associated to tension of the anterior muscle group, fascia of the thigh and *m. iliopsoas*. In addition, because of the long-term hip joint pathology that has congenital or acquired character, adaptive stereotype of movements is formed, both in the joint and in the elements of the musculoskeletal system, involved in the process of walking and sitting, in addition to changes in the functional nature, post anatomical changes (muscle retraction, scoliosis deformity, lumbar lordosis, pelvic distortion, rotational deformity of the lower limb, etc.) are formed, which, after THA appear in conditions requiring reverse development.

The dislocation cases of both group's patients were analyzed with the possibility of further prediction of the probability of it development during the whole period of the study from the moment of surgery (Kaplan-Meier survival analysis).

Fig.3 Graph of the cumulative proportion of patients by Kaplan-Meier survival analysis

As we can see from the Kaplan-Meier survival graph (Fig. 3), there is a significant difference between the groups. According to the findings, it can be argued that the risk of hip arthroplasty dislocation in patients undergoing posterior strengthening of the capsule joint with the PM was significantly less than in the control group. At the same time, the proportion of patients in whom this complication may not develop in the main group was 82.4%, which is better than in the control group - 64.9% by 17.5%. It should be noted that the critical period for the development of dislocation was the first year after surgical treatment, during which almost half of all cases of this complication were observed in both groups, it was especially important in the control group of patients who had THA with posterior-lateral approach and suturing of the joint capsule structures in the strained way by classical method, that is not inconsistent with literary sources. However, the cumulative proportion of patients without dislocation in the study group at the end of the first year

after surgery was 9.5% higher than in the control group and was 96% vs 86.5%, respectively. Among the factors that led to the development of dislocation in patients of both groups, 7 cases, the first place took the violations of the orthopedic regime and exceeding the allowable range of motions of the operated limb - 4 cases, traumatic genesis 3 cases, due to falling on operated limb. In 5 (71.4%) cases, patients required surgical treatment in the form of revision prosthesis with component reorientation and capsule reconstruction. Thus, it can be argued about the positive results of the PM use for the treatment and prevention of hip endoprosthesis dislocation.

Conclusions

1. Strengthening the soft tissue structures of the hip joint capsule with a mesh implant based on polypropylene reduces the risk of dislocation after arthroplasty by 9.5% during the first year after surgery and by 17.5% after 3 years, provided that the components of the endoprosthesis are correctly positioned and patient implements conditions of the orthopedic regimen.

2. The use of PM for strengthening the posterior capsule-soft tissue structures of the hip joint leads to increased functionality of the operated limb and improves treatment outcomes by 1.25 times after 12 months and 1.12 times after two years post-OP according to the Harris Hip Score.

3. Strengthening of the hip joint soft tissue structures using PM leads to better prognostic results of primary and revision surgery.

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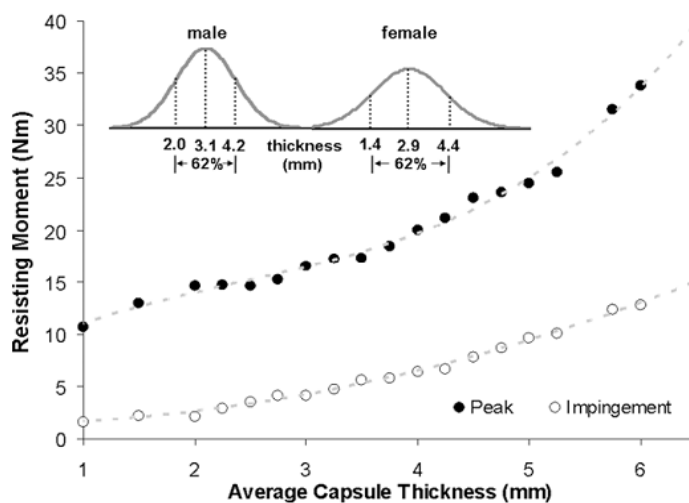


Fig.1. Resisting moment developed during hip flexion versus capsule thickness. Insert curves are reported from the data of Dihlmann et al [9]

Table 1

Number of patients	47
Gender (%)	male 27 (57,4), female 20 (42,6)
Age, years (range)	57
The nosological forms for which the hip replacement was performed:	
Primary coxarthrosis, n (%)	18 (38,3)
Patients with femoral neck or acetabulum fractures, n (%)	13 (27,6)
Dysplastic coxarthrosis, n (%)	6 (12,8)
Idiopathic aseptic necrosis of the femoral head, n (%)	10 (21,3)
Surgical treatment:	
Primary THA, n (%)	26 (55,3)
Revision surgery, n (%)	21 (44,7)
Risk factors for dislocation after arthroplasty:	
Disturbance of orthopedic regimen in the postoperative period, n (%)	8 (17,02)
BMI >30, n (%)	30 (63,83)
Age of patient (>60 years), n (%)	20 (42,55)
Hip injuries and previous surgery on the joint, n (%)	20 (42,55)
Posterior approach, n (%)	47 (100)
Repeated closed reduction (2 times or more), n (%)	7 (14,89)
Instability of endoprosthesis components, n (%)	10 (21,27)
Malposition of components, n (%)	2 (4,26)

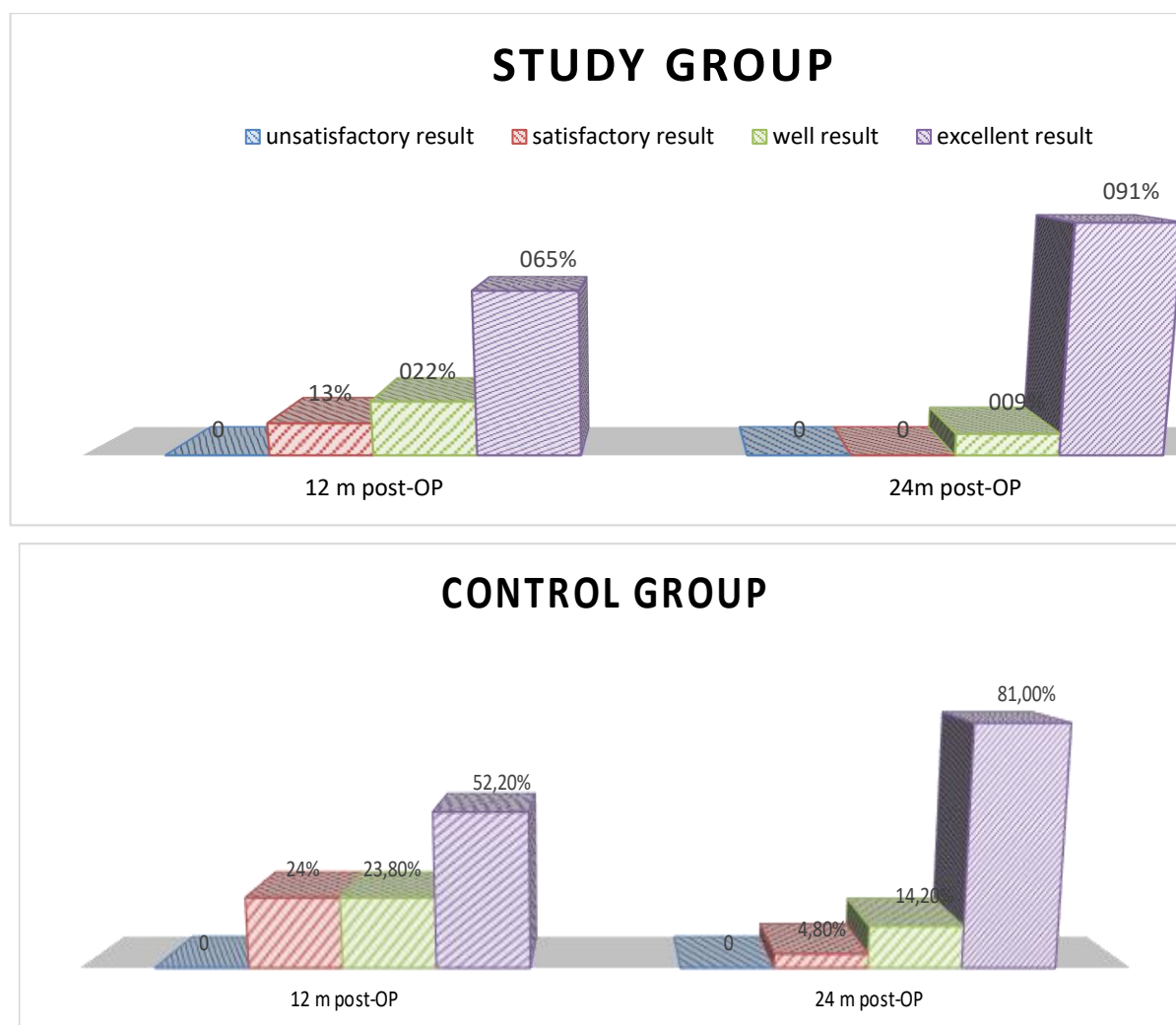


Fig.2 The allocation of patients in both groups by the total Harris Hip Score

Harris Hip Score (HHS) evaluation after 12 and 24 m post-OP (M±m, points)

	Study group, n=24		Control group, n=23	
	12m	24m	12m	24m
HHS (total)	90,6±4,67	96,47±2,8	89,38±5,97	95,09±3,22
HHS (pain)	39,13±4,58	42,43±1,99	38,95±5,42	42±2,34
HHS (static-dynamic function of the operated limb)	42,86±3,01	44,69±2,97	41,52±4,13	44,28±3,71

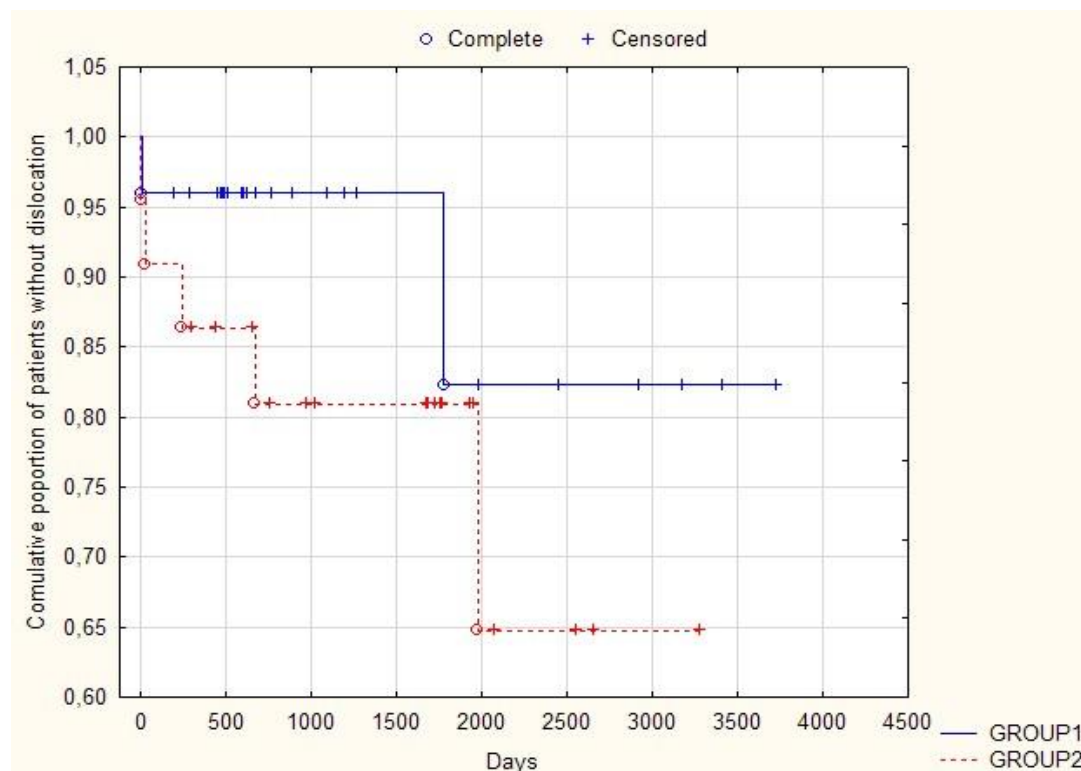


Fig.3 Graph of the cumulative proportion of patients by Kaplan-Meier survival analysis

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INFLUENCE OF VEGFA GENE POLYMORPHISMS RS2010963 AND RS699947 ON CLINICAL AND LABORATORY INDICATORS IN DIABETIC RETINOPATHY AMONG PATIENTS WITH TYPE 2 DIABETES MELLITUS

Abstract. A key factor in the development of neovascularization in diabetic retinopathy (DR) in patients with type 2 diabetes mellitus (DM2) is Vascular Endothelial Growth Factor (VEGF). The important role of VEGFA gene polymorphisms is highlighted by numerous studies and meta-analyses showing their association with DR, particularly with its proliferative form (PDR), which varies in different populations.

Objective. To investigate the relationship between polymorphic genotypes rs2010963 and rs699947 of the VEGFA gene and clinical signs and laboratory parameters of DR in patients with DM2 in the Ukrainian population.

The study involved 302 patients with DM2 and DR. The diagnosis was determined according to the International Clinical Classification adopted by the American Academy of Ophthalmology (2003). The control group included 98 people without DM2, DR or other ophthalmic diseases. All patients underwent cataract surgery. The level of VEGFA in intraocular fluid (IOF) collected during the surgery was measured using the enzyme-linked immunosorbent assay (ELISA) method. Analysis of polymorphic DNA loci of the VEGFA gene – rs2010963 and rs699947 – was performed by real-time polymerase chain reaction using unified TaqMan Mutation Detection Assays Thermo Fisher Scientific test systems (USA).

Analysis of the results of the study showed that the rs2010963 polymorphism influenced the level of VEGFA in IOF (maximum – in the C/C risk genotype). This polymorphism was associated with gender (C/C genotype was more common in males than females – 3:1), presence of PDR (most comm. only determined in the presence of C/C genotype – 45.4%) and neovascularization of the optic disc (most commonly determined in the presence