

The effects of laparoscopic mesh fixation device on bone, costo-chondral junction and tendon site



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The effects of the laparoscopic mesh fixation device on bone, costa-chondral junction and tendon site: an experimental study

Osteitis pubis is one of the important complications of inguinal hernia repair surgery occurring with the placement of sutures through the periosteum. The aim of this study is to evaluate scintigraphic and histopathological alterations associated with the use of mesh fixation device on pelvic bone, cartilage and tendons in an experimental animal model. Twenty New-Zealand young male rabbits were used. A mesh fixation device was inserted at each animal's costa-chondral junction, superior anterior iliac crest, and achilles tendon. One week prior to the surgery and 16 weeks after the operation, scintigraphic evaluation was performed. Histopathological evaluation was performed at the end of study. No nuclear activity or pathological change was found at bone site ($p>0.05$). Foreign body reaction was evident at the tendon and costa-chondral site ($p=0.001$).

In conclusion; the mesh fixation device leads to foreign body reaction in costa-chondral junction and tendon. It does not cause any nuclear activity increase.

KEY WORDS: Foreign body reaction, Inguinal hernia, Laparoscopy, Mesh fixation device

Introduction

Laparoscopic hernia repair is a popular and effective technique, offering a more rapid recovery and less pain than the conventional open approach. In this technique, a mesh is fixed in the preperitoneal space with sutures, staples, anchor, or other mechanical methods to avoid displacement which leads to recurrence. However, the

issue of mesh fixation in totally extraperitoneal (TEP) laparoscopic repair of inguinal hernia remains to be resolved. The need for fixing the mesh arises from the concerns about increasing hernia recurrence rates. On the other hand, specific complications have emerged as a result of mesh fixation such as neuralgia, recurrence of hernia and osteitis pubis ¹.

Osteitis pubis was first described by Beer in 1924 in patients who had undergone suprapubic surgery and remains a well-known complication of invasive procedures about the pelvis ². However, it may occur as an inflammatory process in athletes, runners and ice hockey players, often with seemingly insignificant trauma ^{3,4,5}. In athletes, osteitis pubis is regarded as a problem of overuse, with instability and movement of the anterior pelvis ^{6,7}. The typical history is of gradually increasing unilateral or bilateral discomfort or pain in the pubic

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area ^{8,9}, or both groins (adductor areas), and the area of the lower rectus abdominis muscle ^{10,11}. The incidence and etiology of osteitis pubis as an inflammatory process versus an infectious process continues to be controversial among physicians when confronted by a patient who presents complaining of abdominal pain or pelvic pain and overlapping symptoms.

Previous studies reported that osteitis pubis can be a complication of a variety of pelvic surgeries including abdominoperineal resection, inguinal herniorrhaphy, endoscopic resection of the prostate, and transrectal prostate biopsy ^{12,13}. It was reported that this complication occurs with the placement of sutures through the periosteum ^{2,14}. Some authors suggested that staple use may contribute to the resurgence of this complication.^{1,15} In the urogynecologic literature, this condition was reported after anterior colporrhaphy, retropubic urethropexy, and even after periurethral collagen injection². The aim of this study is to evaluate scintigraphic and histopathological alterations associated with the use of mesh fixation procedure on pelvic bone, costa-chondral cartilage and tendons in an experimental animal model.

Materials and methods

This study was ethically approved by the local ethics committee. Twenty New-Zealand young male rabbits weighing between 2.5 and 4 kg were used. All animals were acclimated in the vivarium for at least two weeks. Rabbits were individually housed in stainless steel cages. They were fed with standard rabbit chow and received water ad libitum. One week prior to the surgery, whole body bone scintigraphy of the rabbits were done by Tc99m-5mci given at bone dose. Animals were fasted overnight prior to surgery. Anesthesia was induced with intramuscular injection of 100 mg/ml Ketamine (Ketalar, Pfizer, Turkey) and 20 mg/mL xylazine (Rompun, Bayer, Turkey) solution. Additional anesthesia was administered via the marginal ear vein to maintain the animal on a surgical anesthetic plane. All surgical applications were performed under aseptic conditions and the sterile technique was used.

Approximately 3-4 cm area at the costa-chondral junction, superior anterior iliac crest and achilles tendon region was shaved. Following disinfection of with 10% Povidine-Iodine solution, access was gained by 1 cm dermal incision with number 15 sterile surgical blade. Then, mesh fixation device (Protack 5mm, United States Surgical, Norwalk, USA.) was inserted to costa-chondral junction, superior anterior iliac crest and achilles tendon of each animal. Finally, skin incisions were closed by 3/0 silk sutures (Dogusan, Turkey).

Scintigraphic re-evaluation of the bones was performed at 16 weeks postoperatively. By the end of this period, all animals were sacrificed by high dose ether. For histopathological evaluation with hematoxylin-eosin

staining, mesh fixation staples along with the surrounding tissues (1 cm apart) were excised. Anterior superior iliac crests were excised using an osteotome.

Scintigraphic and histopathologic results were evaluated by chi-square test and $p < 0.05$ was accepted as statistically significant.

Results

The scintigraphic evaluation revealed that none of the tissues revealed an increase in the nuclear activity in the 16-week postoperative period (Fig. 1, 2) ($p > 0.05$). Histopathologic evaluation did not demonstrate any statistically significant pathological changes at the bone site ($p > 0.05$). However, there were significant alterations at the costa-chondral junction and achilles tendon ($p = 0.001$) (Fig. 3, 4). Intense foreign body reaction and tenofascial fibrosis existed at the tendon site in addition to an increase in the osteoblastic activity and synovial cell proliferation with chronic synovitis at the costa-chondral

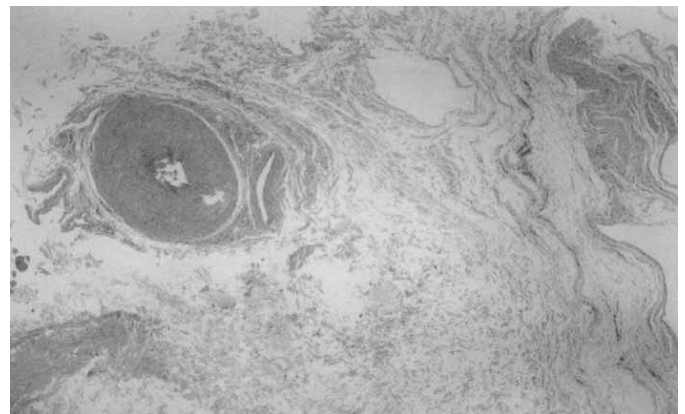


Fig. 1: Scintigraphic evaluation of the rabbit one week prior to surgery

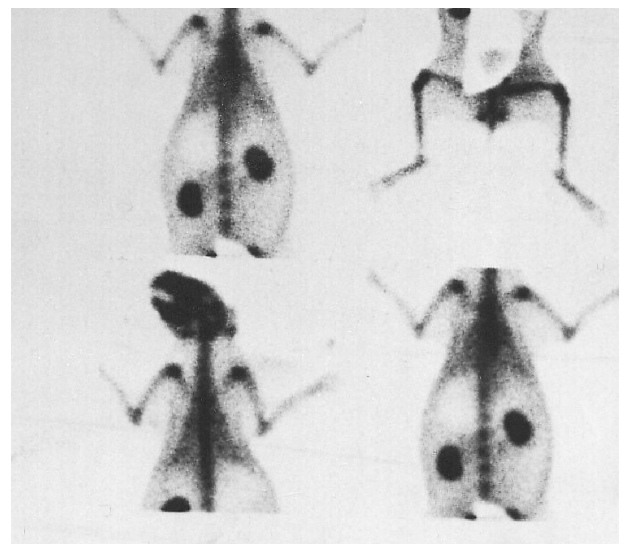


Fig. 2: Scintigraphic evaluation of the rabbit 16 weeks after the operation

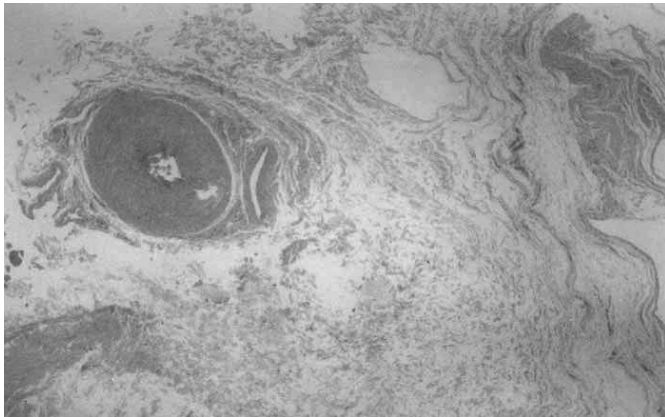


Fig. 3: H&E x40 (Mixoid degeneration at tendon site)



Fig. 4: H&E x100 (Foreign body reaction at costa-chondral site)

TABLE I - Histopathologic and Scintigraphic data

	Case	%
Histopathologic evaluation Tendon*		
+	17	85
-	3	15
Costa-chondral site*		
+	20	100
-	-	-
Bone		
+	2	10
-	18	90
Scintigraphic evaluation		
Preoperative		
+	-	-
-	20	100
Postoperative		
+	-	-
-	20	100

(*) The difference was statistically significant (p=0.001).

site. The most significant changes were noted at the costa-chondral site (p=0.001). The results are summarized at the Table I.

Discussion

Inguinal hernia repair contributes significantly to the workload of general surgeons. Due to the increasing field of applications of laparoscopic techniques in surgery, laparoscopic inguinal hernia repair has become more popular. Total extra peritoneal (TEP) repair is the most commonly preferred surgical technique in this field. This technique simply involves the placement of a polypropylene mesh in the preperitoneal space. Surgeons fix this mesh in place by using laparoscopic stapling devices and suturing techniques. The need for fixing the mesh arises from the concerns about increasing hernia recurrence rates. However, specific complications have emerged as a result of mesh fixation such as neuralgia and osteitis pubis.¹ Abdominoperineal resection and inguinal herniorrhaphy have also been complicated by osteitis pubis^{12,13}. Postoperative osteomyelitis is rare and originates from infectious agents^{16,17}, but osteitis pubis is a noninfectious, self-limited inflammatory condition of the symphysis pubis associated with urologic and gynecologic surgical procedures, trauma, connective tissue disorders, and pregnancy^{18,19}. In obstetrics and gynecology, one of the first cases was reported by Painter after a traumatic forceps vaginal delivery²⁰. The first case series that included 10 patients associated with pregnancy and one patient developing in the post-operative period after an anterior colporrhaphy, was reported by Wiltse and Frantz²¹. Even with the Marshall-Marchetti-Krantz procedure, where sutures are placed directly into the periosteum or cartilage of the symphysis pubis, osteitis pubis has been regarded as an uncommon complication occurring only in 1% to 2.5% of the cases. No difference was observed in regard to the type of suture used including permanent (silk, Tevdek) or absorbable (catgut)^{22,23}. Ordorica et al.²⁴ reported the development of osteitis pubis in disabling complications with slings for managing female stress urinary incontinence. Moreover, it may also involve the adjoining pubic bones, the perichondrium, and the periosteum.²⁵ Although it is a well-known complication of various genitourologic procedures, the association between hernia repair and osteitis pubis has been rarely documented in the literature¹.

The main hypotheses for the cause of postoperative osteitis pubis includes trauma, impaired vascular circulation, trophic bone changes related with a causalgia-like mechanism and infection^{2,18,19,22,26}. Furthermore, symphysis pubis is a nonsynovial-lined, amphiarthrodial junction located between the two pubic bones. Traction, micro trauma and instability of sacroiliac joint and symphysis pubis may also be the possible causes of osteitis²⁷. Yet, the exact cause of this condition remains unclear. Nevertheless, some authors suggested that staple or suture use may contribute to the resurgence of this complication^{1,15}. Studies of biopsy material reveal mild to moderate inflammatory cell reaction, associated with primarily plasma cells and lymphocytes. If disease is more

severe, there is polymorphonuclear leukocyte infiltration in addition to local hemorrhage and ossification²⁸. However, foreign body reaction (staple) has not been very comprehensively evaluated until today. During inguinal hernia repair, a helical fastener is usually stapled into the ligament of Cooper. Therefore, a helical fastener (Protack®) was stapled to the anterior-superior iliac crests, costa-chondral junctions and Achille's tendon in the present study for the evaluation of its effects on these tissues. In our study, significant histological changes including an intense foreign body reaction were recorded whereas no lymphocytes, hemorrhage or ossification were observed at the costa-chondral junction and tendon site.

Diagnosis of osteitis pubis is based on classical clinical symptoms (suprapubic pain, difficulty and pain with ambulation) and abnormal radiographic findings. Scintigraphy using Technetium-99m usually shows an increased uptake at the symphysis pubis more prominent than the pubic tubercle^{29,30}. The symmetry of the uptake helps to rule out tumors, tendinitis, strains, and pelvic stress fractures, all of which are characteristically asymmetric³¹. Holt et al.⁶ studied the athletes with normal AP radiographs and demonstrated bone scans showing an increased radiotracer (99mTc) uptake throughout the area of the symphysis pubis as a characteristic of osteitis pubis. In a study of male patients with symptoms consistent with osteitis pubis, Buck and co-workers³² noted that 23% of the patients had x-ray findings that were not diagnostic. However, sup 99m Tc-MDP bone scan was positive in all cases. In addition, bone scan findings are usually positive before plain film findings are observed³⁰. However, in the present study, the scintigraphy did not reveal any increase in the nuclear activity that may lead to the diagnosis of osteitis pubis.

The research presented here does have limitations. First, patients usually refer with symptoms relevant with this condition after surgery. However, this study presented here is an experimental study conducted on animals. Second, all studies published to date regarding surgical intervention of osteitis pubis have been troubled by small patient numbers. It would be more preferable to be able to follow all patients after inguinal hernia repair surgery. Thereby, it would give a more accurate idea of the outcomes of laparoscopic mesh fixation procedure and increase the clinical significance of the study. But, this poses numerous logistical problems, and it is unlikely that it is possible to do such research. Ideally, multi-centered studies involving the regular follow-up of all hernia operations for a long time period and the interpretation of the pooled data need to be designed so that the outcome of the treatment methods can be compared accurately.

In conclusion, it should be kept in mind that osteitis pubis may be among the complications of pelvic surgery. However, it is clear that mesh fixation device only leads to a foreign body reaction in costa-chondral junction

and tendon and it does not result in any pathological changes at the bone sites.

Riassunto

L'osteite del pube è una delle complicazioni importanti della riparazione chirurgica dell'ernia inguinale, che si verificano con l'apposizione di punti di sutura attraverso il periostio.

Lo scopo del presente studio è quello di valutare scintigraficamente e su base istopatologica le alterazioni che si associano all'uso di dispositivi di fissaggio della rete protesica all'osso pelvico, alla cartilagine ed ai tendini in un modello sperimentale animale su venti conigli della Nuova Zelanda, di sesso maschile.

In ogni animale è stato inserito un dispositivo per la fissazione di mesh alla giunzione costo-condrale, sulla cresta iliaca superiore anteriore e sul tendine di achille. Una settimana prima dell'intervento e 16 settimane dopo è stato effettuato un controllo scintigrafico. Al termine dello studio è stata effettuata una valutazione istopatologica.

A livello osseo non è stata rilevata alcuna attività nucleare né cambiamenti patologico ($p < 0,05$). È stata evidente una reazione da corpo estraneo nella sede tendinea ed alla giunzione costo-condrale ($p < 0,001$).

Pertanto si può concludere che i mezzi di fissazione della mesh comporta una reazione da corpo estraneo in corrispondenza della giunzione costo-condrale ed in sede tendinea, che non determina nessun incremento dell'attività nucleare.

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