

## RESEARCH ARTICLE

### Comparison of Three Different Suture Materials for Toggle Pin (TP) Technique in Induced Hip luxation in Dogs

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#### Abstract

This research was performed at Veterinary Surgery clinic, Faculty of Veterinary Medicine, Zagazig University, Egypt to compare between three different suture materials for toggle pin technique in induced hip luxation in dogs. This comparison includes complications during surgery and post-operative clinical evaluation of each case. The study was conducted on 12 apparently healthy mongrel dogs (dewormed and quarantined for 2 weeks). These animals were preoperatively evaluated for normal hip joint by X-ray, and then were subjected to induced hip luxation. The twelve dogs were divided into 3 groups based on the type of suture materials. The first group was toggle pin (TP) using monofilament polypropylene suture material 2 USP. The second group was TP using multifilament polyester suture material 5 USP. The third group was TP using stainless steel wire size 0.5mm. Evaluation of these animals post-operative was conducted based on visual pain assessment, lameness scoring, and luxation recurrence radiographically. The monofilament polypropylene suture material 2 USP used for the 1st group (4 dogs) was found excellent in manipulation and not easily cut post-operative with minimal complications. The multifilament polyester suture material 5 USP used for the 2nd group (6 dogs) was not tolerant where it cut during surgery in 4 cases and 1 week post-operative in 2 cases. The stainless steel wire used for the 3rd group (2 dogs) was difficult to be manipulated during surgery, then femoral head was re-luxated and the wire cut 1 week and 3 weeks post-operative, respectively. The findings of this study proved that monofilament Polypropylene suture material 2 USP was the best material for suturing in TP technique followed by multifilament polyester 5 USP, and finally with stainless steel wire size 0.5mm.

#### Keywords

Toggle pin technique (TP), Hip luxation, Hip joint, Coxofemoral joint.

#### Introduction

A synovial joint is what the hip joint is categorized as (diarthrosis). Despite the joint's primary movements being flexion and extension, a wide range of motion is possible due to the ball and socket design [1]. It has articular cartilage; a joint cavity, a joint capsule, and synovial fluid

like all synovial joints have [2]. The main functions of the dog's hip joint are to connect the back legs to the rest of the body, sustain their weight, and play a significant part in locomotion; Hip joint problems cause lameness and severe arthritis [3].

Animal joints can sustain a variety of injuries of varying severity; the mildest condition is a simple sprain of the associated ligaments and/or joint capsule with no displacement of the articular surfaces; in more serious injuries, the articular surfaces are displaced from their natural placements. The term "luxated" or "totally dislocated" refers to a joint in which there is no contact between the surfaces. Joints are referred to as subluxated or incompletely dislocated when there is some contact between the articular surfaces [4]. Luxation or dislocation is the displacement of one or more bones in a joint from their natural position. Luxation can be categorized as; acute or chronic based on how long the injury has been present, closed or opened luxation depending on presence or absence of dirt in the wound [5]. In approximately 90% of cases, the etiology of hip luxation in affected canines was traumatic [6] of which 60% of them is vehicle accident [7]. The majority of CF (coxofemoral) luxation injuries are unilateral, and due to the large forces required to create the luxation, approximately 50% of affected animals have accompanying severe injuries [8]. The round ligament is frequently avulsed from attaching fovea capitis; in some cases, the joint capsule is also burst [9]. Hip luxation is mostly craniodorsal [7] and less frequently ventrocaudal in which the femoral head may get stuck in the obturator foramen [10]. Luxation of femoral head inside obturator foramen occurs usually due to falling trauma. Femoral head luxate medially in case of acetabular fracture [11]. Most animals are amenable to closed reduction. Open reduction might be necessary in more severe situations and in animals with repeated injuries[8]. To avoid cartilage injury, hip luxation should be corrected as

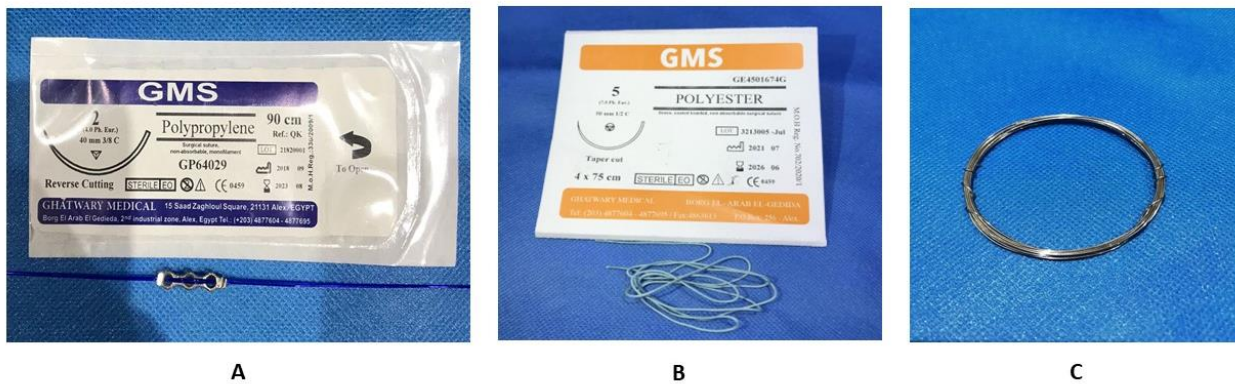
soon as possible [2, 11]. Hip luxation is repaired by closed or open reduction methods. The open reduction includes ostectomy of the femoral head and neck (FHO) and Toggle pin technique [10, 12]. Even though closed reduction is the most popular type of treatment, closed reduction is performed under general anesthesia because it is very painful, and the injured limb is immobilized in an Ehmer sling for 7 to 10 days [6, 13]. Failure rates of closed reduction repairs have been reported to range between 50 and 70 percent [6]. As a result, open reduction strategies are preferred [6]. The main complication of surgical treatment includes re-luxation, nerve injury, infection, cartilage damage or surrounding tissue damage [13]. Knowles *et al.* [14] first described toggle pin stabilization technique in 1953. It depends on a prosthetic head of femur replacement to keep the joint reduced until the periarticular fibrous tissue has developed enough to keep the joint reduced on its own. This method was once promoted as a less invasive, more physiological way to restore the joint that didn't involve immobilizing it after surgery [15, 16]. There is no ideal method for hip luxation treatment [17].

## Material and Methods

This study was conducted at veterinary surgery clinic, faculty of veterinary medicine, Zagazig University, Egypt to compare between three different suture materials for Toggle Pin (TP) technique in induced hip luxation in dogs to distinguish which of them is the material of choice in this technique. The comparison included the strength of each material to tolerate the breakdown after surgery and also tolerate the dogs weight strength as well as which of these materials is easy and malleable during the surgery and the clinical health signs of the hip joint after the surgery. Twelve apparently healthy male dogs were divided into 3 main groups with varied ages ranging from (1-3 years old) and body weight ranged from (14-26 kg). All

procedures were carried out following the guidelines of Zagazig University Institutional Animal Care and Use Committee (ZU-IACUC) under the approval number of ZU-IACUC/2/F/118/2021. The selected dogs were quarantined for 2 weeks for good evaluation of their health status, implementation of an appropriate vaccination

regimen particularly, rabies vaccine, deworming schedules, and external parasite control. Physical and radiographic examinations were performed to confirm the normal anatomy by Toshiba Rotanode (POX-300 BT, Japan) with an exposure factor of 65 KV and 6 mAs [18] (Figure 3A-F).



**Figure 1:** The types of suture material used; **A:** Monofilament polypropylene suture material 2 USP and mini stainless steel plate 2 mm, **B:** Multifilament polyester suture material 5 USP and mini stainless steel plate 2mm, and **C:** Stainless steel wire size 0.5 and mini stainless steel plate. All of them were from Ghatwary Medical, New Borg El Arab Alex Egypt.

### Surgical procedure

The selected dogs were grouped into 3 groups. The 1st group (n=4 dogs) underwent to TP using monofilament polypropylene suture material 2 USP and mini stainless steel plate 2 mm (Figure 1A). The 2nd group (n=6 dogs) underwent TP using multifilament polyester suture material 5 USP and mini stainless steel plate 2mm (Figure 1B). The 3rd group (n=2 dogs) underwent TP using stainless steel wire size 0.5 and mini stainless steel plate 2mm (Figure 1C).

*Induction of the hip dislocation according to Knowles et al. and Morgan [14,19].*

For surgery, the hip area was aseptically prepared. Antibiotic injection (Synulox® amoxicillin and clavulanic acid, Zoetis USA) was applied 2 hours prior to surgery at a dose of 8.75 mg/kg BW (7.0 mg amoxicillin, 1.75 mg clavulanic acid) equivalent to (1 ml/20kg BW I/M). Xylazine hydrochloride (Xylaject 2% Adwia Pharmaceutical Co. 10th Ramadan City, Egypt) was used to sedate the animals at a dose of 0.5 mg/kg I/M [20]. Followed by general anesthesia of the animals with Propofol 1% (B. Braun Germany), 5 mg/kg BW I/V [17]. A craniolateral approach to the hip joint was used. Skin incision, subcutaneous tissue dissection, and blunt dissection between the superficial gluteal and tensorfacialata muscles running down to the cranial edge of the biceps femoris muscle.

Blunt dissection between vastus lateralis muscle and deep gluteal muscle. Then deep gluteal tendon partial tenotomy was performed. A joint capsule incision is made. By cutting the round ligament, femoral head

luxation is induced (Figure 2A). Then the femoral head elevation was done by hohman retractor. Precautions was regarded to avoid any harm to the femoral nerve, artery, and vein.



A

B

C

**Figure 2:** Shows; **A:** The exposure of the head of femur (induction of luxation) after joint capsule opening to facilitate the next step which is drilling in the acetabular fossa and fovea capitis, **B:** The suture material stuck in the acetabulum after insertion of the plate with the suture material in the hole which is drilled in the acetabular fossa to fix the joint from medial aspect, and **C:** The tying of the suture material on the plate to fix it laterally in the greater trochanter and now the joint was fixed from laterally and medially.

*Toggle pin technique according to Knowles et al. and Morgan [14,19].*

A 3.5mm drill bit was used to make a hole through the acetabular fossa. Next, a femoral bone tunnel was started with a 3.5mm drill bit at the fovea capitis and extended laterally toward the greater trochanter. A tight rope was inserted into toggle button, that was inserted into the drilled acetabular hole and it was important to ensure that the button was stuck well in the hole (Figure 2B). Then guide wire was inserted in drilled femoral hole in the greater trochanter medially toward fovea capitis at the level of the

round ligament. The two ends of the rope were inserted into the loop of the guide wire, and then the guide wire was pulled from greater trochanter side. The two ends of the rope were then inserted into the toggle button. Gentle tension was made to the rope to ensure femoral head seated well in the acetabulum then the two ends of the rope were tied together on the plate at the greater trochanter of the femur (Figure 2C). Finally, routine suturing of the joint capsule, muscles, subcutaneous tissue and fascia and the skin were carried out.

*Post-operative care*

Flunixin meglumine (Finadyne® MSD) was injected once daily at a dose of 1mg/kg I/M to manage surgical pain three successive days from the day of the surgery [21]. The antibiotic was given as an injection of amoxicillin and clavulanic acid (Synulox® Zoetis USA) at a dose of 8.75mg/kg BW 1 ml/20 kg, BW I/M, 6 successive days post-operative. For wound antiseptics, 10% betadine (Povidone iodine) was used. For four weeks, exercise was prohibited. The Elizabethan collar was wrapped around the animal's head to keep it from licking, scratching, or opening the wound.

*Follow-up*

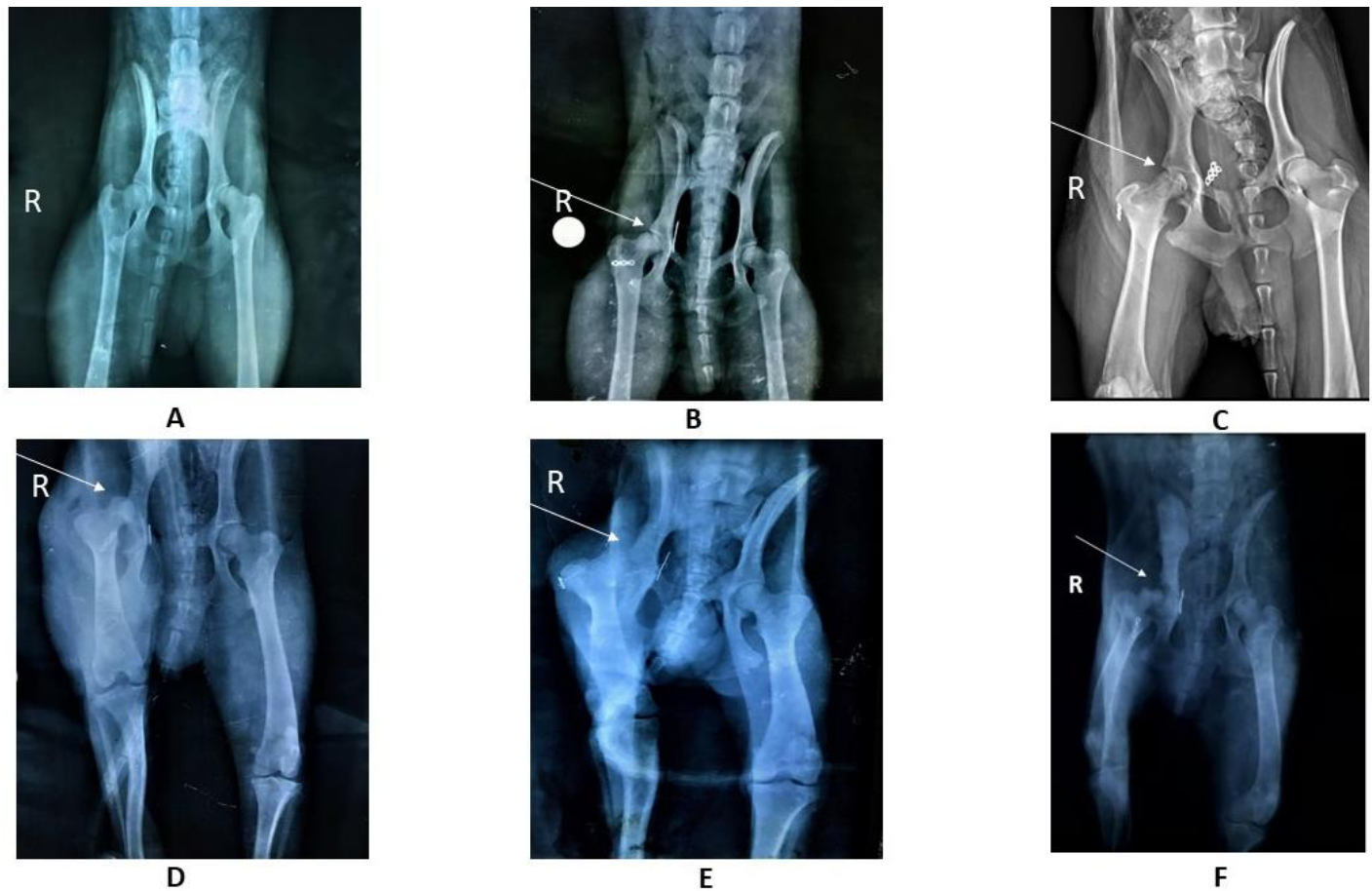
Each case was clinically and radiographically investigated using a Toshiba Rotanode (POX-300 BT, Japan) radiographic machine with exposure factors of 65 KV and 6 mA [18]. At day 0 and weekly for 12 successive weeks; The Follow up included clinical examination and signs of pain, infection of the wound, lameness, crepitus, and the motion range of the treated hip joint [22]. Additionally, a plain x-ray was performed in the ventrodorsal (VD) position while animal was sedated with Xylazine hydrochloride (Xylaject 2% Adwia Pharmaceutical Co. 10th Ramadan City, Egypt) at a dose of 0.5mg/kg I/M [19].

**Results**

Monofilament polypropylene suture material 2 USP used for the 1st group was excellent in manipulation and not easily cut post-operative with minimal complications (Figure 3B). However, multifilament polyester suture material

5USP used for the 2nd group (Figure 3C) was not tolerant where it was cut during surgery in 4 cases and replaced with another one, while in the remaining 2 dogs, the suture material was cut 1week post-operative (Figure 3D). On the other hand, stainless steel wire size 0.5mm used for the 3rd group was difficult to be manipulated during surgery and femoral head was re-luxated after 1 week then the wire was cut 3 weeks post-operative (Figure 3E). Four dogs of the total 12 examined underwent osteoarthritis (coxitis) 4 weeks post-operative (Figure 3F).

All dogs (except the dogs which underwent suture material breakdown and suffer from hip joint re-luxation Figure 3D, 3E) started; ground toe touch 1week post-operative and weight bearing with nonpainful lameness 3 weeks post-operative. At the fifth week, there was mild nonpainful lameness with weight bearing. After the 12th week, there was no lameness but slight abnormal gait. There was no crepitation during clinical examination except 4 cases (1 case in polypropylene group and 3 cases in multifilament polyester group) which suffer from coxitis and osteolysis post-operative (Figure 3F). Normal locomotion angle was observed during the clinical examination without palpable difference between normal leg and the leg which dislocated and fixed with toggle pin technique. The findings of this study proved that monofilament Polypropylene suture material 2 USP was the best material for suturing in TP technique followed by multifilament polyester 5 USP, and finally with stainless steel wire size 0.5 mm.



**Figure.3:** X ray image showing; **A:** Normal ventrodorsal (VD) plain x ray preoperative for the operated dogs, **B:** Monofilament polypropylene suture material size 2 USP and mini stainless steel plate size 2mm as a toggle pin technique in the right hip joint, **C:** The multifilament polyester suture material size 5 USP and mini stainless steel plate size 2mm as a toggle pin technique in the right hip joint, **D:** Re-luxation of the right hip joint and breakdown of the multifilament polyester suture material size 5 USP after 1 week from surgery, **E:** The breakdown of the stainless steel wire size 0.5mm 3 weeks post-operative in the right hip joint, and **F:** Osteoarthritis and osteolysis 4 weeks post-operative in right hip joint of dog which was fixed using toggle pin technique using multifilament polyester suture material size 5 USP and mini stainless steel plate size 2 mm.

## Discussion

The most often luxated joint in dogs is the coxofemoral joint [23-25]. The aim of surgical procedure is to maintain anatomical and physiological function of the hip joint at a long run [16]. This research proved that aim as all successful cases start walk again and their hip joints restore their function and anatomical position. Meheust *et al.* [15] and Flynn *et al.* [16] stated that Toggle pin failure and re-luxation ranges from 7-29%. This failure may be due to cutting of suture material such as polyester, nylon, and stainless steel wire. Moreover, Lins *et al.* [10] said that within 7 days, one dog in the TP group of 10 dogs underwent re-luxation of the femoral head from acetabulum and this failure was due to suture material failure. This is in consistent with the findings of this study as 4 cases of 12 dogs underwent complication of suture material failure post-operative.

Lins *et al.* [10] reported suture material failure during reoperation in one out of 10 dogs of the toggle pin group, and a new toggle pin with a thicker monofilament suture was placed. This is in agreement with this study where the monofilament polypropylene suture material was the best suture materials used. Meheust *et al.* [15] reported that the possibility of infection and sinus formation in different anatomical regions increases up on using of non-absorbable suture material but not in toggle pin fixation in the dogs. This result coincides with our results where no complication of infection or sinus was recorded in any the 12 dogs studied.

Brinker *et al.* [2] stated that craniolateral approach provide perfect exposure of femoral head and acetabulum. This result is like that recorded in this

work where in this approach the femoral head clearly defined after dissection of the covering muscles and surgeon can luxate it easily. Slatter [7] stated that limb disuse atrophy and soft tissue adhesion may occur as a complication. That result contradicted with this study as there is no disuse limb atrophy in any of the successful cases and may disuse atrophy present due to failure of toggle pin technique suture material. In Toggle pin fixation cases, 50% of patient underwent arthritis and its severity depending on repairing degree and minimal surgical invasion trauma and the accidental trauma [15]. Cartilage injury did not occur with independent acetabulum drilling, but it occurred in 6/16 hips where the acetabulum was drilled through the femoral tunnel [24-26]. This explains why osteoarthritis is developed after hip joint stabilization with the toggle pin approach. Also, Segal *et al.* [27] said that 9 of the 12 joints had femoral head cartilage injury in a study and concludes that minimally invasive approach can be used to achieve closed reduction and stabilization of coxofemoral luxation. Because of the relatively high incidence of femoral head cartilage loss, refinements to the procedure may be required before its use in clinical instances. This result agrees with ours because 4 dogs out of the 12 dogs underwent osteoarthritis 4 weeks post-operative and this coxitis occurred due to surgical manipulation of the toggle pin technique and drilling which make harmful effect on the joint articular cartilage.

Thigh circumference was higher in the toggle pin group at 30, 60, and 180 days post-post-operative [10]. This result was consistent with the findings of this research due to all successful cases can move freely with normal hip joint motion

range post-operative. The variety of methods that have been recommended for the treatment of hip joint luxation reflects the fact that no single method has consistently shown positive outcomes [28]. Even though the joint will function normally, arthritis of the hip may develop after successful coxofemoral luxation treatment. Complications of surgical treatment of coxofemoral luxation include recurrent luxation, implant migration or failure, neurological impairment, infection, harm to the articular cartilage or periarticular tissues, and surgical costs. Surgical methods, on the other hand, provide more stability and significantly lower the incidence of luxation when compared to closed reduction, which has a much higher recurrence rate [29-22].

In conclusion, Toggle pin fixation is a useful technique that needs the use of specialized tools and materials. The method may be effective in dogs with coxofemoral luxation. The toggle pin fixation fails mostly because of suture material breaking in four cases, two of them were done by multifilament polyester suture material, and another 2 cases were done by orthopedic wire size 0.5. Monofilament Polypropylene suture material was malleable and successful in the applicated 4 cases. Monofilament Polypropylene suture material 2 USP was the best material for suturing in TP technique followed by multifilament polyester 5 USP, and finally with stainless steel wire size 0.5mm and which is not malleable during surgery and easy to be broken. Toggle pin technique may cause osteoarthritis of hip joint (coxitis) post-operative that may occur due to surgical manipulation and drilling which make harmful effect on the articular cartilage. Further research is needed to determine the long-term efficiency of the toggle pin

material and the implementation of this method in various clinical situations.

### Conflict of interest

None of the authors have any conflict of interest to declare

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## الملخص العربي

مقارنه بين ثلاثة أنواع من الخيوط الجراحية أثناء إجراء طريقة التوجل بن في تثبيت مفصل الفخذ بعد إحداث خلع جراحي في الكلاب

محمد جمعه, عبد المجيد المزين, محمد طنطاوى\* و فتحي السداوى  
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تم إجراء هذه الدراسة في قسم الجراحة و التخدير و الأشعة، كلية الطب البيطري، جامعة الزقازيق جمهورية مصر العربية للمقارنة بين ثلاث من الخيوط المختلفة من خلال طريقة التوجل بن في تثبيت مفصل الفخذ بعد إحداث خلع جراحي في الكلاب. وقد تضمنت المقارنة المضاعفات التي حدثت أثناء العملية والتقييم الكلينيكي لكل حالة بعد العملية. تمت الدراسة علي عدد 12 كلب بلدى والتي تزن ما بين 14-26 كيلو جرام. بحالة صحية جيدة ظاهريا وقد تلقوا جرعات الديدان وتم عمل حجر صحي لهم لمدة أسبوعين. تم تقييمها قبل العملية للتأكد من أن مفصل الفخذ لديها سليم وذلك بإستخدام الأشعة السينية. ثم بعد ذلك تم إحداث خلع جراحي لمفصل الفخذ لديها. قسمت الكلاب الي 3 مجموعات. المجموعة الاولى يتم تثبيت مفصل الفخذ المخلوع بإستخدام طريقة التوجل بن بإستخدام خيط أحادي الشعيرات بولي بروبيلين مقاس 2 والمجموعة الثانية تم تثبيت المفصل المخلوع بإستخدام طريقة التوجل بن مع إستخدام بوليستر متعدد الشعيرات مقاس 5 والمجموعة الثالثة تم تثبيت المفصل المخلوع بإستخدام طريقة التوجل بن بإستخدام سلك ستانلستيل مقاس 0.5 ملم. وتم تقييم هذه الحالات بعد العملية بالفحص الظاهري وتحديد درجة العرج وإعادة خلع المفصل مرة أخرى بإستخدام الأشعة السينية. وخلصت النتائج إلي أن المجموعة الأولى (4 كلاب) أثناء العملية وجد سهولة في التعامل مع خيط البولي بروبيلين ولا يتهتك بسهولة بعد العملية و بأقل المضاعفات. بينما كانت المجموعة الثانية (6 كلاب) وتبين أن المادة المستخدمة (البوليستر) كانت سهلة التهتك حيث قطع الخيط المستخدم أثناء العملية في 4 حالات بينما حدث تهتك للخيط في حالتين بعد العملية بأسبوع. وأخيرا في المجموعة الثالثة (كلبين) تبين أن سلك الإستانلستيل كان صعب في التعامل وحدث خلع مرة أخرى في مفصل الفخذ بعد أسبوع ثم حدث قطع في السلك بعد 3 أسابيع بعد العملية. كما عانى 4 كلاب من أصل 12 حالة من إتهابات مفصل الفخذ. والخلاصة من هذه الدراسة أن الخيط البولي بروبيلين الأحادي الشعيرات مقاس 2 كان أفضل مواد الخياطة في التوجل بن ثم البوليستر ثم سلك الإستانلستيل 0.5 ملي.