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Evaluation of fabricated toggle pin with metal wire stabilization for treatment of hip luxation in dogs

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Abstract

Coxofemoral luxation or hip joint luxation is the most commonly occurring injury in dogs and cats. There are different methods in treating this case with different outcomes, toggle pin stabilization technique is one of them. This study aimed to evaluate metal suture with fabricated toggle pin as prosthetic round ligament (teres ligament) for the treatment of hip joint luxation in dogs. The experimental study was conducted of five adult mongrel dogs induced coxofemoral luxation (hip luxation) under general anesthesia, then the induced luxation was reduced by using a fabricated toggle pin from a Steinman pin with metal suture passed through a femero-acetabular tunnel created by electrical drill started from third trochanter and exits at the acetabular fossa passing through the fovea capitis. All experimental animals were followed up clinically for six weeks at two intervals (day 14th, and day 42nd), and radiologically for six weeks at three intervals at day zero, day 28th, and day 42nd. All experimental animals were bearing weight on the affected limb the next day after surgery. The lameness score of all cases was 0/5 representing normal gait at both two- and six-week intervals. The radiological results showed a good reduction in luxated limb along the period of the study. In conclusion, a fabricated toggle pin with metal suture is a good stabilizer for hip luxation cases and provides a rigid fixation for the joint.

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Introduction

Hip luxation is the most common occurring type of joint luxations in dogs and cats (1-3). 79%-83% of luxation cases caused by traffic accidents, other causes may include falls, hip dysplasia, and spontaneous luxations (4,5). In many traffic accidents cases traumatized animals suffer from multiple injury like complete or comminuted fracture of femur, these fractures could be treated by intramedullary pinning, bone plate and bone grafting (6). There are many options can be used to accelerate bone healing, magnesium oxide, hydroxyapatite nano gel, platelet rich plasma, and advanced platelet rich fibrin (7-15). Platelet Rich Plasma has been proved as an effective treatment for proliferation of active chondrocytes (16,17) also, low-power laser, to enhance the healing of fractured bones (18). There are many types of anatomical coxofemoral luxation; craniodorsal, caudodorsal, medial and ventral (19). Seventy-three to ninety-six percent of hip luxation cases is diagnosed in a craniodorsal direction considering as the most common type of luxation (4). Treatment methods based on nonsurgical and surgical techniques. Non-surgical methods are represented by closed reduction, which is considered the initial treatment of choice for acute luxated cases but has a high reported reluxation rate and is contraindicated in complicated cases when evidence of coxofemoral pathology, avulsion fractures, hip dysplasia, and polytrauma exists (1,20,21). Surgical techniques of coxofemoral luxation reduction include capsulorrhaphy (22), extracapsular suture stabilization (23), trochanteric transposition (24), sacrotuberous ligament transposition (25), transarticular pinning (26), deep gluteal muscle tenodesis (27), triple

pelvic osteotomy (28), and toggle pin stabilization (29-31). In most cases, toggle pin stabilization resulted in satisfactory to outstanding long-term outcomes with a low risk of intraoperative complications 4.2% and reluxation 11.1% (32). Toggle pin stabilization replaces the ligament of the femur's head with one or two strands of suture between the femur and the acetabulum in order to preserve coxofemoral reduction until joint capsular repair and periarticular fibrosis occur (33). The most disappointing complication after hip luxation reduction is reluxation at a rate ranging from 0% to 25% with toggle pin stabilization (34). A variety of materials have been used to anchor Toggle pin, including braided polyster (35) using ultrahigh-molecular-weight-polyethylene (32) nylon monofilament suture with different outcome (36).

To best of knowledge, no study was conducted on fabricated toggle pin with metal suture stabilization for treatment of hip luxation in dogs in Iraq. Therefore, the objective of this study was to evaluate the effect of fabricated toggle pin with metal suture in stabilization of hip luxation clinically and radiologically in dogs.

Materials and methods

Fabrication of toggle pin

Fabricated Toggle pin was made from a Steinmann pin (2 mm diameter and 1 cm length) by drilling a hole in the center using a 0.5 mm bur (Figure 1), then passing a metal suture USP 2 through this hole.

Figure 1: Fabricated toggle pin.

Experimental animals

This experimental study included 5 adult mongrel dogs, weighing 15±2kg. The animals housed indoor under the same feed and management conditions, in the animals' house of Veterinary Medicine College, University of Baghdad, after obtaining an official approval from the ethical committee of the college. All experimental animals dewormed by Drontal® Plus.

Ethical approval

The study was reviewed and approved by the scientific committee of the Department of surgery and obstetrics, and the college council session of the College of Veterinary Medicine, University of Baghdad No. 949/ P. G. in April 26th 2022.

Anesthetic protocol

Food and water were withheld for 8 and 2 hours before surgery, respectively. The surgical operation was carried out under general anesthesia; started by intramuscular injection of Atropine sulphate (Advacare, USA) as preanesthetic, the dose was 0.02 mg/kg BW followed by intramuscular injection of a mixture of 1-2 mg/kg BW Xylazine hydrochloride (Alfasan, Holland) and 10-20 mg/kg BW of Ketamine hydrochloride (Alfasan, Holland) (37).

Surgical procedure

Preparation of surgical site aseptically from dorsal midline to the level of stifle joint. Through a craniolateral incision approach to the craniodorsal aspect of hip joint (Figure 2A). A femero-acetabular tunnel was drilled started from the third trochanter and exits at the fovea capitis then acetabular fossa (Figure 2B). The toggle pin was placed in the acetabular hole and pushed through to the medial side. The sutures were pulled through the tunnel and held taut while the hip is reduced to the normal position (Figure 2C). A second hole was then drilled from cranial side of the femur to caudal side. Both pairs of sutures were pulled through this hole and then tied on the lateral side of the femoral cortex. Mattress sutures were placed to the joint capsule then muscles. Simple continuous suturing of subcutaneous tissue, and skin were closed with USP 3-0 polydioxanone (Acufirm, Germany) subcuticular technique (31).

Postoperative care

Amoxicillin (Zoetis, USA) at dose of (22mg/kg BW twice daily) and Ketoprofen (Vetanco, Argentina) at dose of 0.2 mg/kg BW were given intramuscularly to all animals for five consecutive days. Ehmer sling did not applied for all animals, and the exercise was limited to 10 days of cage rest before beginning leash walks.

Lameness score

Lameness scored on 0-5 scale (22). At the day 14th and day 42nd. 0 = representing a normal gait. 1 = mild weight bearing lameness. 2 = moderate weight bearing lameness. 3 = severe weight bearing lameness. 4 = severe intermittent weight bearing lameness. 5 = severe continuous non-weight bearing lameness.

Reduction

The animal is positioned in a dorsal recumbent position, its hindlimbs dragged caudally, extended and rotated inward. In all patients, a ventrodorsal view was taken on the day of

surgery (day zero), day 28th, and day 42nd. Radiographic evaluation was performed using a digital radiograph (Pixxgen Corporation, Korea, Model PIXX1717) at exposure factors of 70-75 kVp and 10 mA/sec (mAs), with a source-to-image distance of 90 cm.

Statistical analysis

The Chi-squared (χ^2) test SPSS software was used to compare the proportion of good reductions and relaxation at three time points (the day of surgery, day 28th and 42nd) for the reduction data (38).

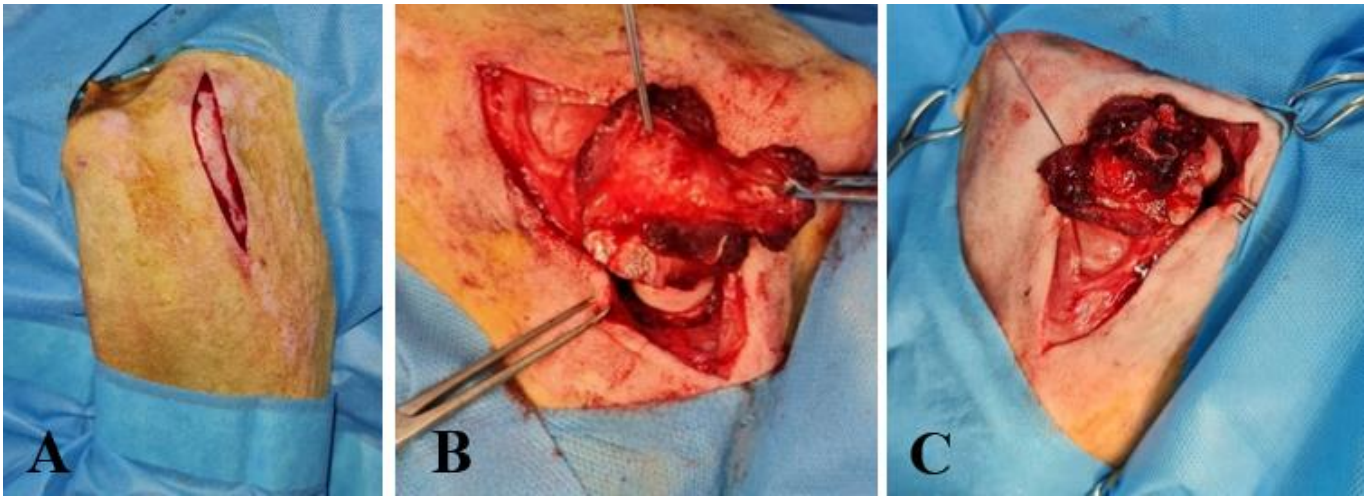

Figure 2: Surgical procedure A: A craniolateral incision. B: Drilling of femero-acetabular tunnel. C: Passing Toggle pin and suture through the tunnel.

Results

All experimental animals didn't loss appetite. There was neither evidence of developed signs of wound complications nor pain. All experimental animals were bearing weight on the affected limb 24 hours after surgery. The movement was restricted for 10 days then started with leash walking for 10 mins maximum and increased gradually. The score at the 14th day for all animals postoperatively was 0/5 which representing a normal gait. The same result continued to the sixth week with all experimental animals.

The radiological examination showed good reduction of all luxated limbs at zero time, at 28th day and the 42nd day (Figure 3). A chi-squared test was used to analyze the reduction outcomes at day zero, day 28th, and day 42nd in five dogs treated with a metal suture with a fabricated toggle pin to fix induced coxofemoral luxation. Five out of five dogs had a good reduction (Tables 1 and 2). There was no difference in the proportion of good reduction and no reduction between the three time points. In addition, there was no pin migration.

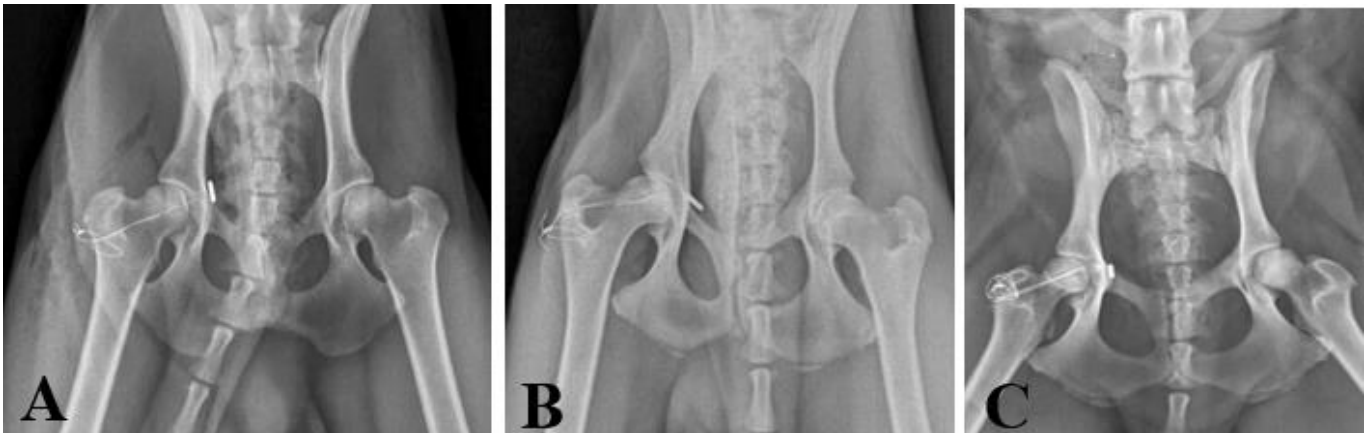

Figure 3: A radiograph shows good reduction of fixation along the period of the study; A:at zero day. B: fourth week. C: sixth week.

Table 1: lameness score along the period of the study

Case number	Day 14th	Day 42nd
Case 1	0/5	0/5
Case 2	0/5	0/5
Case 3	0/5	0/5
Case 4	0/5	0/5
Case 5	0/5	0/5

Table 2: The rate of good reduction and reluxation along the period of study

Reduction	X-Ray		
	Zero day	Four-week	Six-week
Good reduction	100%	100%	100%
Reluxation	0%	0%	0%
Total	5	5	5

Discussion

Toggle pin stabilization consider as a recommended surgical technique when urgent weight bearing on the luxated hip is required due to concomitant orthopedic damage in the contralateral leg (39). In this study, reporting five cases of successful stabilization of hip luxation with fabricated toggle pin stabilization using the metal suture passed through a femero-acetabular tunnel and evaluated clinically by assessment of lameness score and radiographically.

Lameness is a clinical symptom that can be caused by orthopaedic, oncological, or neurological diseases that affect the tissues related to movement and subjective gait analysis provides valuable information to determine the affected limb and structures (40). While there was no statistically difference in lameness scores between week 2 and 6 indicating a positive response to the surgical intervention with the fabricated toggle pin and metal sutures. These results give an agreement with previously reported studies which confirmed that 90% good to excellent recovery and had no or only negligible lameness at a minimum of 6 months after surgery (5).

The current study reported 5 animals 100% of successful reduction of luxated hip with fabricated hip toggle stabilization using the metal suture, this ratio of success is better than the finding of Mathews and Barnhart (36) which treated 128 cases of hip luxation in dogs with toggle rod stabilization using nylon monofilament suture. Reluxation consider as a major complication (41), and its rate was 0% despite other researchers reported high rate of reluxation 11-25% (42,43). This percentage of failure was attributed to the breakage of prosthetic ligament of the head of the femur, reluxation after breakage of the toggle rod or splint, femoral head fracture, and femoral neck fracture by the prosthetic material used (2,44,45). In comparison to other study reported high rate of failure 43.5% in dogs treated with closed reduction and Ehmer sling application with closed reduction (21). This demonstrates the importance of open reduction using toggle pin stabilization with metal suture because of its high success rate.

Mild femoral bone tunnel widening was seen in all dogs on postoperative radiographs at the 28th day examination. This widening may be caused by an implant reaction and subsequent bone reaction, implant micromotion, or infection (2). There was no evidence of any inflammation that attribute the tunnel widening cause to the micromotion of the implant represented by the pin and multifilament metal suture that used in this study. Metal suture fixation provided for an early return to function. Within the first 24 hours following surgery, all dogs who were able to use the limb and did not restrain in an Ehmer sling. Finally, 100% of cases reported an excellent outcome, further research with larger animals' number and longer follow-up periods is recommended to confirm these findings and to evaluate the safety and cost-effectiveness of this types of sutures.

Conclusion

The conclusion of this study is that fabricated toggle pin (1 cm length, 2 mm diameter) is an economic and successful procedure in stabilization of hip reluxation with metal suture which found it's a good stabilizer with the necessity of restriction of animal movements.

Acknowledgments

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Conflict of interest

We declare that there are no conflicts of interest exist.

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تقييم الجبيرة المصنعة من دبوس التثبيت مع الخيط المعدني في علاج حالات خلع مفصل الورك عند الكلاب

مينا قحطان السامرائي و حميد علي التميمي

فرع الجراحة والتوليد، كلية الطب البيطري، جامعة بغداد، بغداد، العراق

الخلاصة

خلع مفصل الورك هو أكثر الإصابات شيوعا في الكلاب والقطط. وهناك العديد من الطرق المختلفة في علاج هذه الحالة بنتائج مختلفة، تقنية التثبيت باستخدام دبوس توكل تعد واحدة من هذه الطرق. حيث هدفت هذه الدراسة إلى تقييم الخيط المعدني مع دبوس توكل كرباط اصطناعي دائري بديل للرباط الفخذي المدور. أجريت الدراسة التجريبية على خمسة كلاب هجينة بالغة أحدث فيها جميعها خلع للفخذ (خلع مفصل الورك) تحت تأثير التخدير العام، ثم تم علاج الخلع المستحدث باستخدام دبوس توكل مصنع من دبوس ستانمان مع خيوط معدنية (ستنلس ستيل) حيث تم تمرير الجبيرة المصنعة عبر نفق فخذي حقي تم إنشاؤه بواسطة المثقاب الكهربائي الذي يبدأ من مستوى المدور الثالث على عظم الفخذ ويخرج عند الحفرة الحُقيّة مرورا بنقرة الرأس لعظم الفخذ. تمت متابعة جميع حيوانات التجربة سريريا لدرجة العرج ولمدة ستة أسابيع على فترتين اليوم الرابع عشر واليوم الثاني والأربعين. توبعت الحالات إشعاعيا لمدة ستة أسابيع على ثلاث فترات يوم إجراء العملية، واليوم الثامن والعشرون، واليوم الثاني والأربعون. كانت جميع حيوانات التجربة تستخدم الطرف المصاب في اليوم التالي بعد العملية مع معدل عرج يساوي صفر والذي يمثل مشية طبيعية خلال الفترتين الأسبوع الثاني والسادس. كما أن نتائج التصوير الشعاعي أظهرت تثبيت جيد لجميع حالات الخلع المستحدثة. يعتبر التثبيت باستخدام الدبوس المعدني مع خيط الستنلس ستيل تقنية ناجحة في علاج حالات خلع مفصل الورك.

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