



RESEARCH ARTICLE

Evaluation of the Results of Toggle Pin or Caput and Collum Femoris Excision Arthroplasty in Cats with Coxofemoral Luxation: A Retrospective Study

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Koksofemoral Çıkık olan Kedilerde Toggle Pin veya Caput ve Collum Femoris Eksizyon Artroplastisi Kullanımının Sonuçlarının Değerlendirilmesi: Retrospektif Çalışma

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Öz

Amaç: Bu çalışmanın amacı, kedilerde koksofemoral çıkık tedavisinde toggle pin artroplastisi ve caput femoris ile collum'un eksizyon artroplastisi yöntemlerinin avantajlarını, dezavantajlarını ve postoperatif sonuçlarını karşılaştırarak değerlendirmektir.

Gereç ve Yöntem: Bu retrospektif çalışmada, 2022-2023 yılları arasında farklı ırk, cinsiyet ve yaşlarda, koksofemoral çıkık problemiyle Küçük Hayvan Kliniği'ne başvuran 20 kedi olgusu incelenmiştir. Çalışmaya dahil edilen olgulardan 11'ine eksizyon artroplastisi, 9'una ise toggle pin artroplastisi uygulanmıştır.

Bulgular: Eksizyon artroplastisi grubunda, 5 olguda (%45.4) postoperatif 2. ayda topallık gözlenmemiş ve yürüme çok iyi olarak değerlendirilmiştir. Diğer 4 olguda (%36.3) ise hafif ve zaman zaman ortaya çıkan yürüme zorlukları gözlemlenmiştir. 2 olguda (%18.1) ise sıkça görülen hafif yürüme zorlukları yaşanmıştır. Aynı olguların 12. ay sonuçları değerlendirildiğinde, 9 olguda (%81.8) herhangi bir yürüme problemi olmadığı, yalnızca 2 olguda yürüyüşte hafif ve ara sıra zorluklar yaşandığı belirlenmiştir. Toggle pin grubundaki 9 olgu arasında, 5 olguda (%62.5) operasyon sonrası 4 ay içinde çıkık tekrar meydana gelmiştir. Kalan 3 olguda (%37.5) ise postoperatif dönemde topallık gözlenmemiştir. Tekrar çıkık meydana gelen 5 olguya eksizyon artroplastisi uygulanmıştır. Sahiplerinin bildirdiğine göre, bu olgularda operasyonun 12. ayında yürüme kısıtlılığı yaşanmamıştır.

Öneri: Eksizyon artroplastisi, özellikle diğer tekniklerin başarısız olduğu durumlarda kedilerde iyi fonksiyonel sonuçlar sağlayan etkili bir kurtarma yöntemi olarak önerilmektedir. Toggle pin artroplastisi, eklemi koruma amacıyla kullanılacak bir teknik olmakla birlikte, tekrar çıkık oranlarının yüksek olduğu ve kullanılan materyalin önemi üzerine dikkat edilmesi gerektiği sonucuna varılmıştır.

Anahtar kelimeler: Kalça çıkığı, Kediler, Topallık

Abstract

Aim: The aim of this study was to evaluate the advantages, disadvantages and postoperative outcomes associated with the use of toggle pin (TP) fixation or femoral head and neck excision arthroplasty (EA) in the treatment of coxofemoral luxation in cats.

Materials and Methods: Twenty cats of different breeds, sexes and ages presenting with coxofemoral luxation to the small animal clinic between 2022-2023 were evaluated. EA was the procedure of choice in 11 cases and TP was the procedure of choice in 9 cases.

Results: In the EA group, 5 patients (45.4%) had no lameness at the 2-month postoperative examination and walked well. The other 4 patients (36.3%) had mild and occasional performance difficulties. In 2 cases (18.1%) there was a mild but frequent difficulty in walking. When the 12-month results of the same patients were analysed, it was found that 9 patients (81.8%) had no problem walking and only 2 patients had mild and occasional difficulty walking. In the TP group, 5 cases (55.5%) showed lameness within 4 months of surgery. No lameness was observed in 4 (44.4%) cats in the same group. EA was performed in 5 cases of reluctance. Owners reported that their cats were not restricted in activity 12 months after surgery.

Conclusion: EA appears to be a rescue technique that can provide good functional results in cats that have failed other techniques. Despite the relaxation rates, the TP used in this study is a good technique that can be used to preserve the joint. The use of different materials should increase the tracking time.

Keywords: Cats, Hip dislocation, Lameness

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Introduction

Trauma-related coxofemoral luxations are frequently seen in cats (Scott and McLaughlin 2007, Meeson and Strickland 2021). Craniodorsal dislocation accounts for 73% of dislocations and is the most common pattern in cats (Basher et al 1986). Excessive load reaching the joint causes dislocation (Piermattei 2011), and approximately 50% of patients have associated major injuries. There is usually also a rupture of the teres ligament. X-rays should be carefully taken to look for damage or fracture to the dorsal rim of the acetabulum, which also helps to stabilise the hip. The diagnosis is made if the greater trochanter is displaced from its normal position. Normally, when the femur is in the acetabulum, it forms a triangle with the anterior trochanter as the most anterior point. However, dorsal/craniodorsal luxation is likely if the greater trochanter is no longer ventral to the ischial tuberosity and iliac wing. The diagnosis requires careful examination for fractures of the acetabulum and femoral head, especially in immature cases. For this purpose, the diagnosis is confirmed by lateral and dorsoventral radiographs. Dorsocaudal dislocations are more common. Caudoventral dislocations are also possible but are much rarer (Arıcan 2020).

Closed reduction and surgical techniques are treatment options. Closed reduction has the best chance of success when done in less than 5 days (Wildgoose 1983, Moores 2006). It should be remembered that closed reduction is contraindicated in fractures of the caput femoris, collum femoris or acetabulum and radiographs should be taken first. There is approximately a 21-50% rate of relaxation after successful closed reduction (Bennett 1975, Wildgoose 1983, Moores 2006, LeFloch and Coronado 2022). However, they are difficult to maintain in cats and do not appear to affect the rate of dislodgement, and soft tissue complications are not uncommon. Clinician preference for strict 2-3 week rest as an alternative. If the hip is easily reducible, there is a greater likelihood of relaxation in the early post-operative phase. Open reduction is usually recommended when the dislocation has been present for more than 5 days, when there is concomitant hip dysplasia or concomitant orthopaedic injury, and when closed reduction has failed (Berzon et al 1980, McLaughlin 1995). Surgery is indicated if closed reduction cannot be achieved or open reduction and stabilisation is indicated if the hip remains unstable. There have been reports of a number of surgical techniques in cats, capsular repair, De Vita pinning, iliofemoral suture, suture of the origin of the rectus femoris, fascia lata loop stabilisation, trochanteric transposition, transarticular stainless steel (Bennett and Duff 1980, Duff and Bennett 1982, Wildgoose 1983, Basher et al 1986, Lubbe and Vestraete 1990, Meij et al 1992, Kawamata et al 1996, Moores 2006, Sissener et al 2009, Çetinkaya and Olcay 2010, Arıcan 2020). When other techniques fail, femoral head and neck excision arthroplasty

and total hip arthroplasty can be used as salvage procedures (Berzon et al 1980, Liska 2010, Off and Matis 2010, Witte et al 2010, Fitzpatrick et al 2012). Stabilizing the joint in cats with a toggle pins is at least as successful as other reported techniques, and those that are successful have excellent longterm limb function. The overall success rate in the study was 86% (Pratesi et al 2012).

For the treatment of caput femoris and collum femoris fractures, including caput femoris physeal fractures, coxofemoral dislocations, acetabular fractures and arthritis excision arthroplasty has been reported in cats (Berzon et al 1980, Basher et al 1986, Off and Matis 2010). The results of excisional arthroplasty in cats have been reported as satisfactory or good in some studies, (Berzon et al 1980, Basher et al 1986, Off and Matis 2010, Harper 2017) but conflicting in others because of concerns about dorsal displacement of the affected femur (Liska et al 2009). In coxofemoral arthropathy in cats, excisional arthroplasty and another alternative in total hip replacement could be used (Off and Matis 2010, Liska, 2010, Liska et al 2010, Witte et al 2010). Excision arthroplasty in dogs is seen with decreased movement and sometimes inability to stand due to muscle atrophy in the post-op period (Liska et al 2009, Off and Matis 2010).

The aim of this study was to evaluate the advantages, disadvantages and postoperative outcomes of toggle pin arthroplasty or femoral head and neck excision arthroplasty for coxofemoral luxation in cats.

Material and Methods

Data

20 cats of different breeds, sexes and ages presenting with coxofemoral luxation and admitted to the Small Animal Clinic between 2022 and 2023 were evaluated. Excision arthroplasty was performed in 11 cases (Table 1) and a toggle pin was used in 9 cases (Table 2). Cats were excluded from the study if there was any orthopedic condition/injury in addition to the coxofemoral joint under investigation, or any medical condition likely to affect mobility. Case selection was random. We only included those patients who were willing to have the operation carried out. Permission was obtained from the clients before the application and information was given. Some patient owners brought their cats to the faculty. They were examined. Scoring was done. Others were phoned and scored according to the information given. The study was carried out with the permission of Selcuk University, Faculty of Veterinary Medicine, Animal Experiments Local Ethics Committee dated 2.11.2023 and numbered 2023/125.

Scoring system, the disability score was given for each activity. A score of 0 meant that the cat was able to perform

Table 1: Distribution (breed, age, sex and history) of cats undergoing excision arthroplasty.

Case	Breed	Age	Sex	Medical History	Excision Arthroplasty
1	Persian	2 years	Female	Left coxofemoral luxation	+
2	Tabby	4 years	Female	Left coxofemoral luxation	+
3	Russian Blue	1 year	Male	Right coxofemoral Luxation	+
4	Tuxedo	1.5 years	Male	Left coxofemoral luxation	+
5	Tabby	2 years	Female	Left coxofemoral luxation	+
6	British Shorthair	11 months	Male	Left coxofemoral luxation	+
7	Tabby	1.5 years	Female	Left coxofemoral luxation	+
8	Hybrid	2.5 years	Female	Right coxofemoral luxation	+
9	Hybrid	4 years	Male	Left coxofemoral luxation	+
10	Tabby	8 months	Male	Right coxofemoral luxation	+
11	Tuxedo	2 years	Male	Left coxofemoral luxation	+

Table 2: Distribution (breed, age, sex and history) of cats undergoing toggle pin.

Case	Breed	Age	Sex	Medical History	Toggle Pin
1	Tabby	3 years	Female	Right coxofemoral luxation	+
2	Tabby	7 months	Male	Right coxofemoral luxation	+
3	Hybrid	5 months	Male	Right coxofemoral Luxation	+
4	British Shorthair	6 months	Female	Left coxofemoral luxation	+
5	Tabby	9 months	Female	Right coxofemoral luxation	+
6	Hybrid	3 years	Male	Right coxofemoral luxation	+
7	Tabby	2.5 years	Female	Left coxofemoral luxation	+
8	Tabby	9 months	Female	Right coxofemoral luxation	+
9	Tabby	3 years	Female	Right coxofemoral luxation	+

the activities without any difficulties; a score of 1 meant that the cat had slight and occasional difficulties performing the activities; a score of 2 meant that the cat had slight but frequent difficulties performing the activities; a score of 3 meant that the cat had significant and permanent difficulties performing the activities; and a score of 4, the highest score, meant that the cat was unable to perform the activities (Yap et al 2015).

Clinical Examination

The primary symptoms of cats with coxofemoral luxation were unilateral severe lameness and inability to bear weight on the affected limb. Clinical examination revealed pain, deformity, crepitation and limited or abnormal movement of the leg in many cases. When both limbs were in extension, the affected limb appeared shorter than the unaffected limb. When the femur was in adduction, the a. genu rotated outwards and the tarsal joint rotated inwards. On palpation, the trochanter major was more proximal than the trochanter major in the unaffected limb and the distance between the tuber ischii and the trochanter major was increased. The animal was placed on its side with the dislocated hip on top and a finger displacement test was performed. The patients were called for post-op examination after 30-60th day. In the 12th month, information was obtained from the animal owners for the cases.

Radiological Examination

Radiological examinations (Sp-HF-4.0 Ralco Spain; Imago, Abbiategrosso, Milano; Regius Model 110 Konica, Minolta) of the cats were performed on pre-op and post-op. X-rays were taken in orthogonal position. Ventro-dorsal position and latero-lateral position.

Toggle Pin Fixation

Domitor (0.04-0.08 mg/kg) was administered prior to general anaesthesia. Anaesthetic was induced with propofol (2-4 mg/kg IV) and maintained with sevoflurane (2.3-3.4%) at 0.70% inspired oxygen. Cats were ventilated with an end-expiratory positive pressure of 5-7 cm H₂O (tidal volume 10 mL/kg, respiratory rate 18-20/min, target end-tidal CO₂ 30-40 mmHg). Clinical assessment and blood and gas levels were continuously monitored.

The length of toggle pin placed in the acetabulum was 1.4 cm and 0.2 cm wide, the length of the thread is 75 cm, the length of the portion placed posterior to the greater trochanter was 1.5 cm and 0.7 cm wide. Multi-filament silk sutures were used. In the operative technique, a bone tunnel was first created in the acetabulum. A toggle pin was passed through the tunnel created in the acetabulum. The attached suture was kept long. Using the same procedure, a tunnel was created on the collum femoris towards the point where the teres ligament attaches to the caput femoris. The toggle pin passed through the acetabulum was held and passed through the collum femoris. The other side of the tunnel was passed



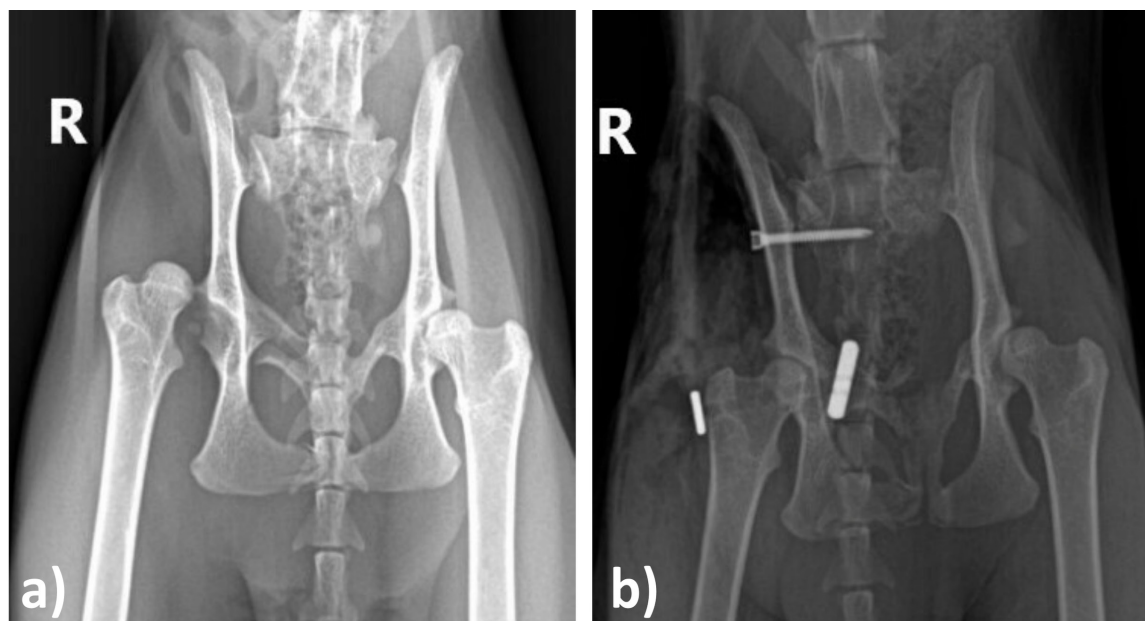


Figure 1. a) Case 9, Tabby, 3 years of age, female, right coxofemoral luxation. b) Case 9, application of a toggle pin after 0 days.

distal to the greater trochanter. Finally, the sutures were secured to the cortical screw placed distal to the greater trochanter (Fig. 1 a and b). Patient movement was restricted.

Femoral Head and Neck Excision Arthroplasty Procedure

An incision was made on the joint capsule in a cranioproximal to caudodistal direction. The overlying articularis coxae was transected. From the femoral neck, approximately the cranial third to half of the origin of the vastus lateralis muscle was elevated. By cutting the round ligament, the femoral head was dislocated. The leg was laterally rotated to 90°. The head and neck of the femur were then exposed using a Hohmann retractor placed caudolaterally to the head of the femur and lateral and external rotational forces were applied to the distal femur to lift the head of the femur from the acetabulum. Careful attention has been paid to the placement of the retractor so as not to entrap the sciatic nerve that runs around the caudodorsal aspects of the hip socket, the deep gluteal muscle and the greater trochanter. Femoral head and neck osteotomy was performed using an oscillating saw after exposure of the femoral head and neck. The osteotomies were performed along a line connecting the middle trochanteric fossa proximally to just proximal to the lesser trochanter in the distal direction (Fig. 2 a,b). This was followed by palpation for sharp or irregular edges and smoothing with a bone grinder. Saline irrigation of the surgical site was performed prior to routine closure. No sutures were used to close the incised joint capsule. The deep gluteus has been sutured to the insertion tendon and the superior lateral gluteus to the cranial edge of the superficial gluteus. Skin sutures were applied and the fascia was closed in layers. All cats were given analgesia (for up to 24-72 hours after surgery) and non-steroidal anti-inflammatory drugs (NSAIDs).

Statistical Analysis

Statistical results are expressed in %.

Results

Toggle Pin Fixation

In the toggle group, 5 cases (55.5%) relaxation within 2 months of surgery (Fig. 3 a-d). In 3 cases (44.4%) in the same group, the cats were able to perform activity without difficulty (Table 3). Excision arthroplasty was performed in all 5 cases with relaxation. According to the owners, at 12 months post-op in all cases, there was no restriction in the activity of the cats.

Table 3: Post-op results of 2th and 12th month disability score of cats with toggle pin.

Case	1-2 months post-op	12 months post-op
1	reluxation	0 (EA)
2	0	0
3	0	0
4	reluxation	0 (EA)
5	reluxation	0 (EA)
6	reluxation	0 (EA)
7	reluxation	0 (EA)
8	0	0
9	0	-

EA: Excision arthroplasty (Excision arthroplasty was performed in the second operation in cases with relaxation).



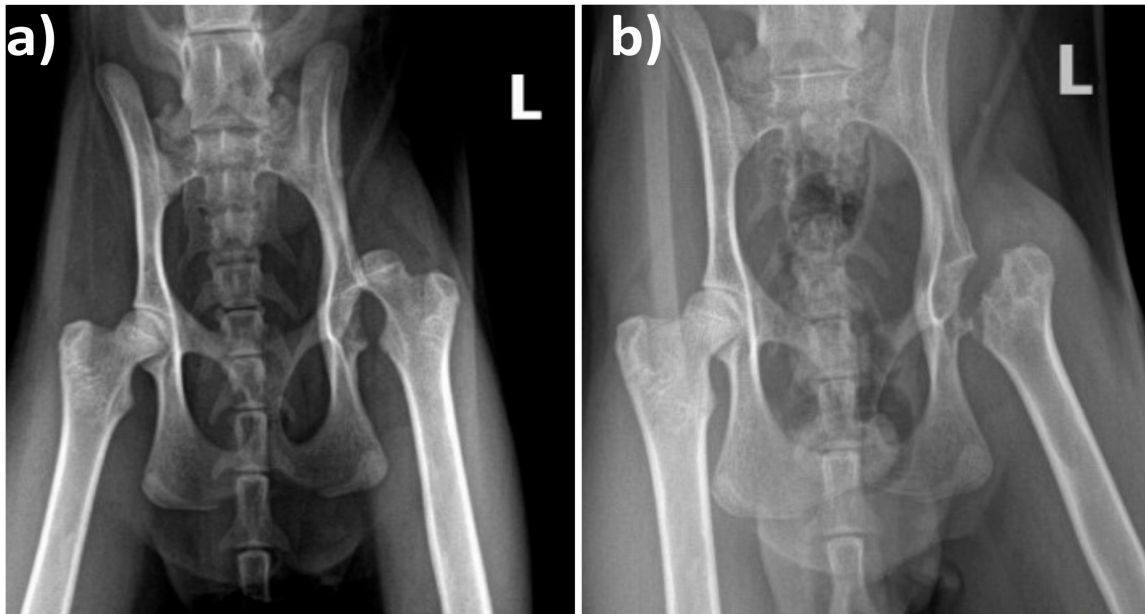


Figure 2. a) Case 7, Tabby, 1.5 years old, left femoral luxation. b) Case 7, arthroplasty of the femur and the neck.

Femoral Head and Neck Excision Arthroplasty Results

According to the information provided by the owners, in 5 cases (45.4%) no restriction of movement was observed at the 2nd month post-operative examination. In 4 cases (36.3%), there was a slight and occasional difficulty in performance. In 2 cases, (18.1%) there was a slight but frequent difficulty in performing the activity. At the 12th month post-op of the same cases, the cats were able to perform the activity without difficulty in 9 cases (81.8%), while only 2 cases showed slight and occasional difficulty in performing this activity (Table 4).

Table 4: Post-op results of 2th and 12th month disability score of cats with excision arthroplasty.

Case	1-2 months post-op	12 months post-op
1	1	0
2	1	0
3	2	1
4	0	0
5	2	1
6	1	0
7	0	0
8	0	0
9	1	0
10	0	0
11	1	0

Discussion

Luxations of the coxofemoral joint are very common in cats (Scott and McLaughlin, 2007). Maintaining the integrity of the joint is the primary goal in hip dislocation. The aim is to preserve the integrity of the joint so that the patient is not at risk of developing osteoarthritis later in life (Clarke and Bennett, 2006). A number of surgical techniques have been described in cats previously (Kawamata et al 1996, Moores 2006, Sissener et al 2009, Çetinkaya and Olcay 2010, Arıcan 2020). Excision arthroplasty and total hip replacement are procedures that should be performed if other techniques fail (Berzon et al 1980, Liska 2010, Off and Matis 2010, Witte et al 2010). In the present study, the toggle pin was used in 9 cases. The success rate of the toggle pins in this study was 44.4%. This rate was found to be lower than literature data 86-92 % (Pratesie et al 2012, Ergen et al 2016, Yurtal et al 2021). Within 1-2 months, there were no problems in the long-term follow-up of the successful cases. But, re-luxation was observed in 55.5% of cases with toggle pins. Also, successful results of toggle application results in dogs have been reported (Karşlı et al 2022).

This high rate of re-luxation was attributed to the silk material in the toggle pin. However, in the remaining cases, re-luxation occurred. The main cause of these luxation was attributed to breakage of the toggle pin suture materials. There were no problems with the application of the homemade pins with a length of 1.4 cm and a width of 0.2 cm. Entry into the acetabulum was achieved with simple manipulation. However, it was felt that the toggle pin was weak due to the multifilament silk suture material. In previous studies, monofilament sutures were reported to be more durable.



Figure 3. a) Case 4, British Shorthair, 6 months, female, left coxofemoral luxation. b) Case 4, application of a toggle pin 0 days after surgery. c) Case 4, relaxation, 4 weeks after surgery. d) Case 4, second operation was excised arthroplasty.

According to Pratesi et al (2012), polydioxanone was chosen as the suture material in these cases because it is absorbable, monofilament and long lasting. Polydioxanone is a resorbable material. This minimises the risk of suture-related infection. Polydioxanone's monofilament nature makes it stiffer than a multifilament suture, and therefore easier to pass through bone tunnels (Pratesi et al 2012). However, silk thread toggle pins were used in this study. The incidence of problems such as rope breakage was also high. A study with polydioxanone in 14 cats included a follow-up period of 15.5 months, recurrence was reported with a rate of 14.3% (Pratesi et al 2012). Çetinkaya and Olcay (2010), reported successful short-term (73 days) outcomes using similar technology (nylon) to treat caudoventral dislocation in cats. The toggle pin used by Rupérez et al (2021) was associated with a low intraoperative complication rate (4.2%), a low relaxation rate (11.1%) and a good to excellent long-term outcome in the majority of cats without relaxation (96.9%). No difference was observed in the rate of postoperative complications or outcome between cats operated with toggle pins made of ultra-high molecular weight polyethylene or nylon. While the recurrence rate was low in all these studies, the reasons for the high recurrence rate in the present

retrospective study were listed as follows. Reasons for relaxation include an operation lasting more than 2 hours (though all our surgery was completed in 45 minutes to 60 minutes), failure of capsulorrhaphy, and home-made toggles are not recommended (Demko et al 2006, Pratesi et al 2012). Homemade toggle pins are not recommended in some studies. However, in studies where homemade toggle pins were not a problem, successful results were obtained. These observations provide evidence that even though they have been described as a modification of the technology, (Fry 1974, Çetinkaya and Olcay 2010, Pratesi et al 2012, Ergen 2016, Knell et al 2023). One of the most important reasons for this was the tearing of the suture material at its interface with the ends of the bone tunnel during the normal movement of the hip joint. Furthermore, the increased number of tunnels and corners may have made it more challenging to achieve a tight and secure construct (Rupérez et al 2021). This is particularly common between 2 and 4 months after the operation. As the cats begin to outdoor freely and climb trees, the stress on the toggle increases. There is also an increase in the incidence of fractures.



Excision arthroplasty was performed in cases of re-luxated. It was observed that the threads of the initial toggle pins were breaking of the rope during surgery. Although the same material was used in 3 cases in the study, it did not break and this was attributed to the fact that these cases were fed under home conditions. All of the cats were able to use the affected limb with a high degree of comfort from the first day after the operation.

In all cases where we performed femoral head and neck excision arthroplasty, satisfaction was recorded. The chances of success in these cases are increased by restricting movement for at least 10-14 days after the operation and ensuring slow movement afterwards. The majority of cats in this study had a return to normal activity time of between 1 and 2 months. 2 months before returning to normal activity. The recovery period and the use of the foot are necessary for the gradual recovery of the amount of pseudoarthrosis, joint movement and muscle mass from joint to joint. In some cases, a lack of activation is observed due to the bones rubbing against each other, whereas an excision line that does not rub against the acetabulum increases the success rate. It is important to note that the following applies the functional result after excision arthroplasty is greatly influenced by ostectomy adequacy, as inadequate ostectomy because joint function will be compromised by an inadequate ostectomy and result in chronic lameness (Off and Matis 2010, Fitzpatrick et al 2012). Caudodorsal malposition of the femur, limb shortening, muscle atrophy are some of the reported changes in objective results measures in cats following excisional arthroplasty. The clinical significance of femoral malalignment after excision arthroplasty is unclear (Liska et al 2010). In a large retrospective study of excisional arthroplasty in dogs and cats, all cats returned to examination 4 to 6 weeks following excisional arthroplasty had moderate muscular wasting and variable degrees of affected joints with reduced range of motion (Off and Matis 2010). However, it was reported that all cats examined were use the affected limb during examination with minimal or no apparent lameness (Off and Matis 2010). In our study, the cats were not examined for muscle atrophy, since not all of them were brought back for examination during follow-up. The owners of the animals we received information from expressed their satisfaction and reported that there was no problem with the movements of the cases. In the meantime, recognised complications of excision arthroplasty include persistent lameness associated with limb shortening, patellar dislocation, sciatic neuralgia and limited hip range of motion associated with severe muscle atrophy (Clarke and Bennett 2006, Liska 2010, Witte et al 2010, Piermattei 2011). We did not encounter these problems in the cats included in the study.

Conclusion

The conclusion of the study was excision arthroplasty is a

salvage technique that results in good functional results in cats. However, joint preservation is always essential. If joint preservation techniques fail and there is a fracture of the caput femoris or collum femoris, excision arthroplasty is always an option. It is the thread material rather than the technique that is responsible for the recurrences and re-dislocations observed with toggle pins. The toggles used in this study are a good technique to be used for the protection of the joint, despite the re-luxation rates. The small number of cases was considered as a limitation of the study. The effectiveness of toggle pins should be compared using different suture materials. Follow-up periods should be increased by using different materials.

Conflict of Interest

The authors declared that there is no conflict of interest.

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Author Contributions

Motivation: MA; Desing: MA; Idea/Concept: MA; Supervision/ Consultancy: MA; Data Collection and/or Processing: IS, HC, MA; Analysis and/or Interpretation: MA, IS, HC; Writing the Article: MA; Critical Review: MA, IS, HC

Ethical Approval

The study was approved by the Selçuk University Faculty of Veterinary Medicine Animal Experiments Local Ethics Committee (SÜVDAMEK) on 02.11.2023, with the decision numbered 2023/125.

