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RESEARCH ARTICLE

Treatment Techniques of Femoral Quadriceps Muscle Contracture in Ten Dogs and Two Cats

Sinan ULUSAN * Ozge CAPTUG-OZDEMIR * Irem GUL-SANCAK * Hasan BILGILI *

* Ankara University Faculty of Veterinary Medicine Department of Surgery, TR-16110 Ankara - TURKEY

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Summary

This study was performed on 10 dogs and 2 cats, were shown quadriceps contracture (QC). The etiological history was indicated that QC occurred as a result of improper bandage application or operations due to femoral fractures in 11 cases or congenital in one case. Long-term immobilization (for 35-45 days) in a bandage and deficiency of rigid fixation with hyperextention on stifle joint caused QC. Hyperextension on stifle and hock joints, hardness on femoral quadriceps muscle (FQM), atrophy of FQM and affected limb, genu recurvatum, patella alta and coxofemoral luxations were observed on cases. According to the degrees of QC, combined treatment methods such as; external skeletal fixation, cuneiform osteotomy of femur, isolation of adhesions, "Z" type myoplasty of FQM, tibial tuberosity transposition, stifle arthrodesis or extremity amputation were applied on cases. The outcomes were "good" for 9 cases, "poor" for 2 cases and one case couldn't be followed. Prognosis of QC is altered for ages, immobilization time and period, femoral shortening, coxofemoral luxation and patella alta, etc. The whole recovery of QC is extremely poor and lameness is permanent on affected limb, in spite of treatment. In conclusions, distal femoral fractures on juvenile dogs and cats (especially 0-3 months age period) should be treated with an appropriate method and performed rigid fixation. In postoperative period, long-term immobilization in a bandage can be prevented.

Keywords: *Cat, Dog, Femoral quadriceps muscle contracture, Stifle joint*

İki Kedi ve On Köpekte Quadriceps Femoris Kası Kontraktürünün Sağaltım Teknikleri

Özet

Bu çalışma Quadriceps kontraktürlü (QK), 10 köpek ve 2 kedi üzerinde gerçekleştirildi. Olguların etiyolojilerinde QK'nün 11 olguda femur kırıklarının ardından hatalı bandaj uygulanması ya da operasyonu sonucunda, 1 olguda ise, konjenital olarak şekillendiği görülmüştür. Uzun süreli bandaj uygulaması (35-45 gün) ve hiperekstensiyondaki diz ekleminde rijid fiksasyonun bozulması QK'ne yol açmaktadır. Olgularda diz ve tarsal eklemlerinde hiperekstensiyon, quadriceps kasında sertleşme, atrofi ve coxofemoral luksasyon görülmüştür. Quadriceps kontraktürü'nün derecesine bağlı olarak, olgulara; eksternal fiksatör, femurun kuneiform osteotomisi, adezyonların açılması, quadriceps kasının "Z" tip miyoplastisi, tuberositas tibia'nın transpozisyonu, diz eklemi artrodezi ya da amputasyon şeklinde kombine sağaltım seçenekleri uygulanmıştır. 9 olguda "iyi", 2 olguda "zayıf" sonuç elde edilirken, 1 olgu'nun takibi yapılamamıştır. Quadriceps kontraktürü'nde prognoz; yaşa, immobilizasyonun süresi ve periyoduna, femoral kısalığa, coxofemoral luksasyona ve patella alta'ya bağlı olarak değişmektedir. Quadriceps kontraktürü'nde iyileşme genelde zayıftır ve ilgili ekstremite de topallık kalıcıdır. Sonuç olarak; juvenil köpek ve kedilerde (genellikle 0-3 aylık dönemde) distal femur kırıkları uygun tedavi yöntemi ile sağaltılmalı ve rijid fiksasyon uygulanmalıdır. Postoperatif dönemde ise bandaj ile uzun süreli immobilizasyondan kaçınılmalıdır.

Anahtar sözcükler: *Diz eklemi, Kedi, Köpek, Quadriceps femoris kası kontraktürü*

INTRODUCTION

Quadriceps Contracture (QC) is a disease which is seen as a congenital deformity [1-3] or as a complication of puppies fractures of the femur [1-5]. This disease is also known as posttraumatic stifle joint rigidity, quadriceps tie-down syndrome [3,5,6], stifle joint hyperextension, hindlimb rigidity [6], quadriceps ischemic contracture or Sudek atrophy [1,4].

İletişim (Correspondence)
+90 312 3170315
hbilgilitr@yahoo.com

Quadriceps contracture generally occurs in 3-month-old puppies [1,2,4], is also known as the critical period, as a result of improper treatment of distal femoral fractures [6-9] and fixation methods [2,5,10-14], long-term immobilization in a bandage [4,5], besides, traumas on distal region of the femur, local ischemia, haematoma, contusion of muscle, repeated patellar luxation, fractures of the tibia [1,6,15] and complication of toxoplasmosis [3]. This disease was seen on cats according to some literatures [16,17]. The metabolical, biomechanical, biochemical and structural changes are indicated on the soft tissues, are affected by long-term immobilization [18,19]. These changes are seen on youngs more frequently than the older dogs [1,4,18,20].

Some colleagues reported various techniques on treatment of QC, such as; isolation of adhesions, "Z" type myoplasty of FQM, femoral cuneiform osteotomy, Kirschner-Ehmer External Skeletal Fixator [1-4,6,16,17].

The aim of this study is to report the detailed pre-operative, operative and postoperative findings and attempts of treatment methods in 10 dogs and 2 cats with QC.

MATERIAL and METHODS

This study was carried out on 10 dogs and 2 cats within different breed, age and sex, all of which were presented to Ankara University Faculty of Veterinary Medicine Clinic of Orthopaedics and Traumatology.

The clinical *(Fig. 1a, 1b, 1c* and *9a*) and radiological examinations of the hip *(Fig. 2* and *8a)* and stifle joints *(Fig. 3a, 3b* and *8b)*, femur and patella were done. Quadriceps femoris muscle (FQM), range of motion of stifle *(Fig. 4a)* and hock joints *(Fig. 4b)*, FQM atrophy, pain, hip joint function, abduction and adduction ranges, etiology, were evaluated in detail. The patella, hip and stifle joints were examined radiographically in mediolateral and bilateral extended and registered.

They were premedicated with midazolam (0.2 mg/kg, IM) and ketamine HCl (10 mg/kg, IM) and maintained on isoflurane in oxygen. Following the shaving and dis-infecting process of the contractured region, this area was bordered with the sterilized clothes.

According to the degrees of the QC [20], one of the following operations or their combinations were made under general anaesthesia; isolation of adhesions, "Z" type myoplasty of FQM, cuneiform osteotomy of femur, excision arthroplasty and unilateral external skeletal fixation (ESF) with Polymethylmetacrylate (PMMA), Manuflex and Ilizarov's Circular External Skeletal Fixation (CESF) system. The hind-limb is maintained in semi-flexion with a bandage or ESF for 2 weeks to encourage lengthening of the FQM during the healing process and an improved limb posture.

The stifle joint motion range was regained by FQM "Z" type myoplasty in 6 cases (Case no: 1, 2, 6, 7, 8 and 10). During the operation, due to the damage of the stifle joint components and extreme recurvation of the femoral condyle, it was decided that QC could not be cured, so amputation was applied in one case (Case no: 4). In one case (Case no: 5), arthrodesis had to be made to the stifle joint. One case (Case no: 6) couldn't be followed due to the patient's owner. In three cases (Case no: 2, 3 and 8), cuneiform osteotomy were performed. The contracture was tried to be treated with PMMA ESF in one case (Case no: 10), Manuflex ESF in one case (Case no: 9), and Ilizarov's CESF system in three cases (Case no: 7, 11 and 12).

Postoperative analgesia was provided with carprofen (2.0 mg/kg orally) starting the following day and continued daily for 3 days only for dogs. The owners were recommended to apply passive extension and flexion motions (10 min, 2 times in a day, for one week) on stifle and hock joints for the cases, except Case no: 4 and 5.

An evaluation scale was determined for limb function for our FQM cases (Ulusan et al. scale) as; "good" no lameness, using limb comfortably weight bearing on limb on each step; "sufficient" lameness, using limb uncomfortably not weight bearing for 3-4 step, "poor" lameness, no using limb during walking and resting *(Table 1)*.

Table 1. *Evaluation scale for limb function for quadriceps contracture. (Ulusan et al. scale)*

Table 1. *Quadriceps kontraktürü için ekstremite değerlendirme skalası (Ulusan ve ark. skalası)*

Degree	Function of Limb
Good	No lameness, Using limb comfortably weight bearing on limb on each step
Sufficient	Lameness, Using limb uncomfortably not weight bearing for 3-4 step
Poor	Lameness, No using limb during walking and resting

RESULTS

Etiology

In this study, each case had been operated or bandaged beforehand due to the femoral fracture, except one congenital case (Case no: 9). All cases were in 2.5-5-month age period. Postoperative bandaging had been applied for 35-45 days in 9 cases (all case exception of Case no: 9) which was a contraindication. In 8 cases (Case no: 2, 3, 7, 8, 9, 10, 11 and 12) hip luxation occurred and excision arthroplasty was carried out.

Clinical Examination Results

In all cases, in clinical examination, rigidity and tension were found in FQM and stifle joint was in hyperextension.

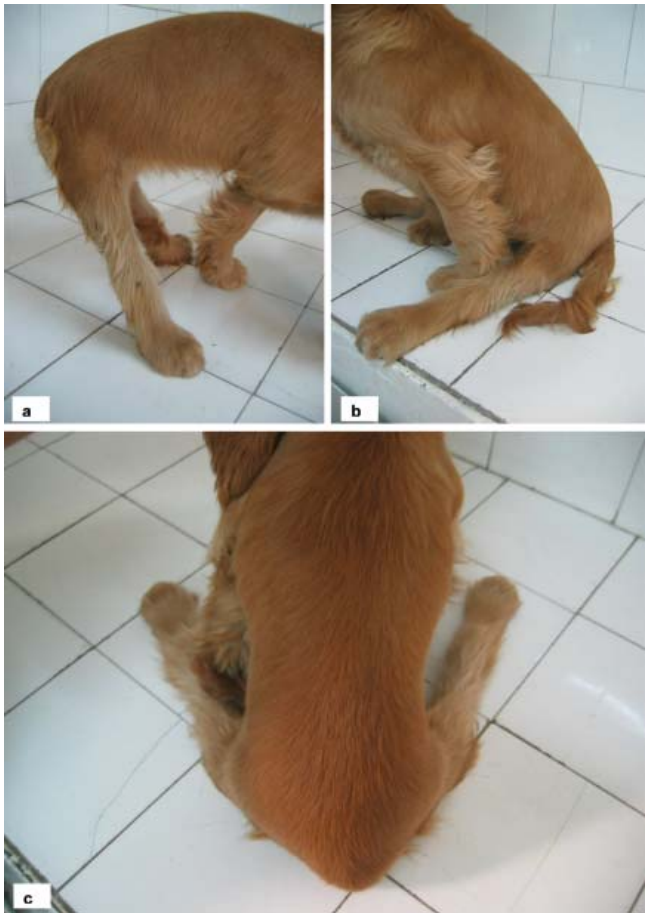

Fig 1 a, b, c. Different clinical views of case no: 9 with QC

Şekil 1 a, b, c. QC'lü olgu no: 9'un değişik klinik görünümleri

Fig 2. Preoperative ventrodorsal (V/D) radiological view of case no: 9 (Bilateral luxation on hip joint)

Şekil 2. Olgu no: 9'un preoperatif ventrodorsal (V/D) radyografik görünümü (Bilateral kalça eklem luksasyonu)

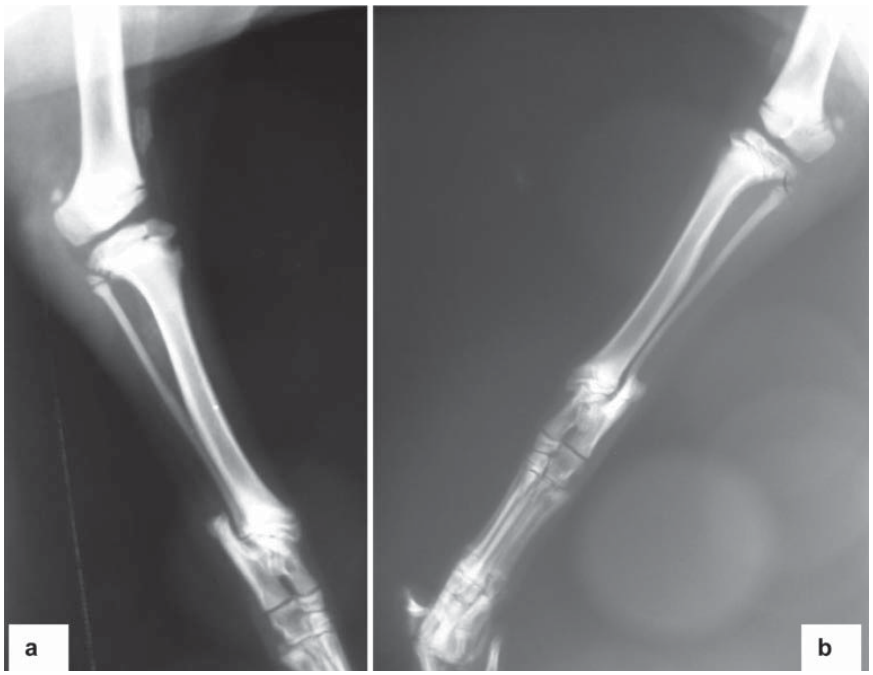

Fig 3a, 3b. Preoperative radiological mediolateral (M/L) views of both stifle joints of case no: 9 (Genu recurvatum and patella alta)

Şekil 3a, 3b. Olgu no: 9'un her iki diz ekleminin preoperatif mediolateral (M/L) radyografik görünümleri (Genu recurvatum ve patella alta)

Palpation of the extremity which was contractured, indicated that FQM was too taut and firm. In addition, it was atrophied and the stifle was hyperextended to such an extent that it bent backward (genu recurvation). In all cases, vastus intermedius muscle adhered to the diaphyseal mid and distal 1/3 region of femur and the range of

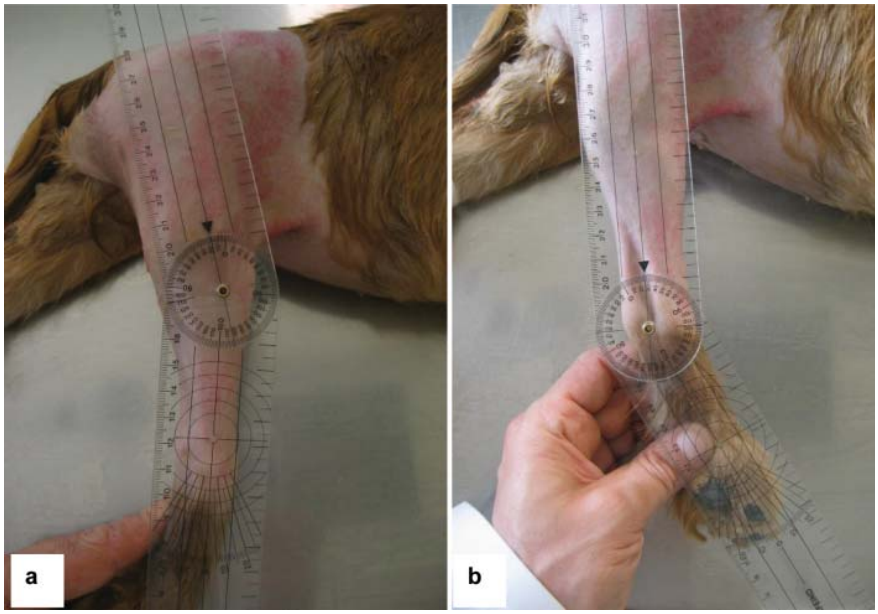

Fig 4. Preoperative clinical views of measurement of joint angles for stifle **(a)** and hock joints **(b)** with a goniometer in case no: 9

Şekil 4. Olgu no: 9'da preoperatif diz **(a)** ve tarsal **(b)** eklem açılarının goniometre ile ölçülmesine ilişkin klinik görünümler

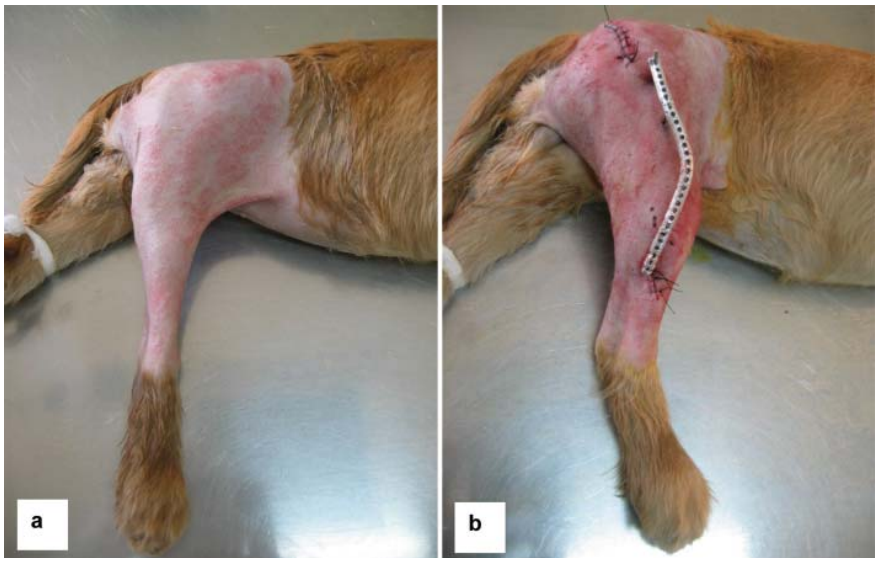

Fig 5. a) Preoperative and **b)** Postoperative clinical views of QC on right hindlimb in case no: 9 (using with Manuflex external fixator and regaining of normal joint angle on stifle)

Şekil 5. Olgu no: 9'un sağ arka ekstremitesindeki QC'nün pre **(a)** ve postoperatif **(b)** klinik görünümleri (Dizdeki normal eklem açısının manuflex eksternal fiksatörü kullanılarak sağlanması)

motion in the stifle joint limited to 0-15° for goniometric measurement.

Radiographic Results

In radiological examinations, it was found that patella was displaced proximally, was called patella alta, due to the contracture of the FQM in all cases and also genu recurvatum. The coxofemoral luxation was determined in 8 cases (Case no: 2, 3, 7, 8, 9, 10, 11 and 12) related to the FQM tension; however, the bone hypoplasia was shown in one case (Case no: 10).

Operative Results

The isolation of adhesions and "Z" type myoplasty were applied in only 2 cases (Case no: 1 and 6), graded "good". However, isolation of adhesions, "Z" type myoplasty, femoral cuneiform osteotomy and excision arthroplasty were performed to be regain of flexion on stifle joint in 4 cases with chronic QC (Case no: 2, 3, 8 and 10), graded "good". And isolation of adhesions, "Z" type myoplasty, excision arthroplasty tibial tuberosity transposition and Manuflex® external skeletal fixator *(Fig. 5a, 5b)*, were applied successfully in a case (Case no: 9), were also graded "good" *(Fig. 6, 7a, 7b)*.

The stifle arthrodesis was evaluated in a case (Case no: 5), such as "good"; although, the hindlimb amputation (Case no: 4) was graded "poor". Ilizarov's CSEF (Case no: 7) were not treat successfully to QC, were graded "poor". Also, other Ilizarov's CSEF (Case no: 11 and 12) were graded "good" *(Fig. 9b, 10a, 10b)*.

The detailed information about all cases was given in *Table 2*.

Table 2. *Detailed information about pre-and postoperative outcomes of 12 cases with quadriceps contracture*

Tablo2. *Quadriceps kontraktürlü 12 Olguya ait pre ve postoperatif detaylı bilgiler*

Case No	Case Signalment	Affected Limb	Etiology	Treatment	Postoperative Follow-up	Results
1	Dog, Terrier, ♂, 2.5-month-old	QC (R) Genu recurvatum and patella alta, Flexion angle of stifle joint 10°	Femoral fractures for 1.5 months ago, Treatment with bandaging for 42 days	Isolation of adhesions, "Z" type myoplasty of quadriceps muscle (vastus lateralis), "Full" range of flexion angle for stifle joint	2 weeks postoperative PVC coaptation bandages (flexion position for stifle joint)	Good
2	Dog, Collie, ♂, 3-month-old	QC (L) Genu recurvatum and patella alta, Coxofemoral luxation (L), Flexion angle of stifle joint 0°	Femoral fractures for 2 months ago, Treatment with bandaging for 45 days	Isolation of adhesions, Closed cuneiform ostotomy and IM pin application on femur, "Z" type myoplasty of quadriceps muscle (vastus lateralis), Excision arthroplasty for coxofemoral luxation, "Full" range of flexion angle for stifle joint	2 weeks postoperative PVC coaptation bandages (flexion position for stifle joint)	Good
3	Dog, German shepherd, ♀, 3-month-old	QC (R) Femoral mal-union Genu recurvatum and patella alta, Coxofemoral luxation (R), Flexion angle of stifle joint 0°	Femoral fractures for 2 months ago, Treatment with IM pin application, bandaging for 42 days	Isolation of adhesions, Closed cuneiform ostotomy and IM pin application on femur, "Z" type myoplasty of quadriceps muscle (vastus lateralis), Excision arthroplasty for coxofemoral luxation, "Full" range of flexion angle for stifle joint	During 1 week postoperative PVC coaptation bandage (flexion position for stifle joint)	Good
4	Dog, German shepherd, ♀, 5-month-old	QC (L) Genu recurvatum and patella alta, Bone lysis on femoral chondyle, Flexion angle of stifle joint 15°	Femoral fractures for 3 months ago. Treatment with bandaging for 35 days	Impossible treatment of QC, Amputation of hindlimb (L)	Amputation	Poor
5	Cat, Van mix, ♀, 5-month-old	QC (R) Genu recurvatum and patella alta, Flexion angle of stifle joint 10°	Femoral fractures for 3 months ago, Treatment with IM pin application, bandaging for 45 days	Arthrodesis for stifle joint (R) with trans-articular pin application from tibia to femur	Arthrodesis	Good
6	Dog, Great Dane, ♂, 5-month-old	QC (L) Genu recurvatum and patella alta, Flexion angle of stifle joint 10°	Femoral fractures 4 months ago, Treatment with IM pin application, bandaging for 40 days	Isolation of adhesions, "Z" type myoplasty of quadriceps muscle (vastus lateralis), "Full" range of flexion angle for stifle joint	During 2 weeks postoperative PVC coaptation bandage (flexion position for stifle joint), No follow-up after 2 weeks	No follow-up
7	Dog, Dobermann, ♀, 4.5-month-old	QC (L) Genu recurvatum and patella alta, Coxofemoral luxation (L), Flexion angle of stifle joint 0°	Femoral fractures for 2 months ago, Treatment with IM pin application with organic material, bandaging for 35 days, Physiotherapy for QC and proximal epiphysiolisis of tibia (L) due to extreme force for stifle joint	Isolation of adhesions, Removed of exuberant callus tissue, "Z" type myoplasty of quadriceps muscle (vastus lateralis), Cerclage application for epiphysiolisis on tibia proximalis. "Full" range of flexion angle for stifle joint, Ilizarov's CESF applications for preserving of stifle range of motion	Removal of Ilizarov's CESF on postoperative 2 weeks	Poor
8	Cat, Mix, ♂, 4-month-old	QC (L) Femoral mal-union, Genu recurvatum and patella alta, Coxofemoral luxation (L), Flexion angle of stifle joint 0°	Femoral fractures for 2 months ago, Treatment with bandaging for 43 days	Isolation of adhesions, Closed cuneiform ostotomy and DCP Plate (with 7 holes, 3.5 mm diameter) pin application for femur, "Z" type myoplasty of quadriceps muscle (vastus lateralis), Excision arthroplasty for coxofemoral luxation, "Full" range of flexion angle for stifle joint	During 2 weeks postoperative PVC coaptation bandage (flexion position for stifle joint)	Good
9	Dog, Cocker Spanial, ♀, 4-month-old	Congenital bilateral QC (L/R) Genu recurvatum and patella alta (L/R), Coxofemoral luxation (L/R), Flexion angle of stifle joint 15° (L/R)	Congenital (4 brothers in one pregnancy. The others are normal)	Isolation of adhesions, Bilateral transposition of tibial tuberosity (firstly L-side was operated, after 30 days R-side), Bilateral "Z" type myoplasty of quadriceps muscle (vastus lateralis), Bilateral excision arthroplasty for coxofemoral luxation, "Full" range of flexion angle for stifle joint, Manuflex® external skeletal fixator applications for preserving of stifle range of motion	Removal of Manuflex® on postoperative 2 weeks	Good
10	Dog, Mix, ♂, 5-month-old	QC (L) Bone hypoplasia, Genu recurvatum and patella alta, Coxofemoral luxation (L), Flexion angle of stifle joint 0°	Femoral fractures for 2 months ago, Treatment with IM pin application, bandaging for 40 days	Isolation of adhesions, Removed of exuberant callus tissue, "Z" type myoplasty of quadriceps muscle (vastus lateralis), Excision arthroplasty for coxofemoral luxation, "Full" range of flexion angle for stifle joint, PMMA external skeletal fixator applications for preserving of stifle range of motion	Removal of PMMA on postoperative 2 weeks	Good
11	Dog, Mix, ♂, 6-month-old	QC (R) Genu recurvatum and patella alta, Coxofemoral luxation (R), Flexion angle of stifle joint 0°	Femoral fractures for 3 months ago, Treatment with IM pin application, bandaging for 45 days.	Isolation of adhesions, Transposition of tibial tuberosity, Excision arthroplasty for coxofemoral luxation, "Full" range of flexion angle for stifle joint. Ilizarov's CESF applications for preserving of stifle range of motion	Removal of Ilizarov's CESF on postoperative 2 weeks	Good
12	Dog, Labrodor, ♂, 5-month-old	QC (L) Genu recurvatum and patella alta, Coxofemoral luxation (L), Flexion angle of stifle joint 10°	Femoral fractures for 2 months ago, Treatment with IM pin application, bandaging for 44 days	Isolation of adhesions, Excision arthroplasty for coxofemoral luxation, "Full" range of flexion angle for stifle joint, Ilizarov's CESF applications for preserving of stifle range of motion	Removal of Ilizarov's CESF on postoperative 2 weeks	Good

QC: *Quadriceps contracture,* ***R:*** *Right,* ***L:*** *Left,* ***DCP:*** *Dynamic Compression Plate,* ***IM:*** *Intramedullary,* ***PMMA:*** *Polymetilmethacrylate,* ***CESF:*** *Circular External Skeletal Fixator,* ***PVC:*** *Polyvnylchloridine*

Fig 6. Clinical view of right stifle joint on postoperative 30th day of case no: 9

Şekil 6. Olgu no: 9'un sağ diz ekleminin postoperatif 30. gündeki klinik görünümü

DISCUSSION

When comparing the etiological factors, clinical, radiological and pathological examinations in our cases with available literatures, they are accorded with a number of limited articles [1-4,6,11,12,16,17]. Recurrent extreme passive motions caused bleeding, rupture of muscle and adhesions in the region [6]. Extreme manipulations must be avoided in reduced motion range of stifle joint, in QC cases [1,3,5,6]. In this study, proximal tibial epiphysiolysis was caused by hyperflexion during physiotherapy in one case.

Before any treatment, QC must be considered as a complicated disease and for this reason [3]; radiological and clinical examinations must be done attentively [1,4]. The ultimate outcome of cases with QC depends on the duration of immobilization [18], age, and extent to which other complications such as hip luxation, patella alta, osteo-

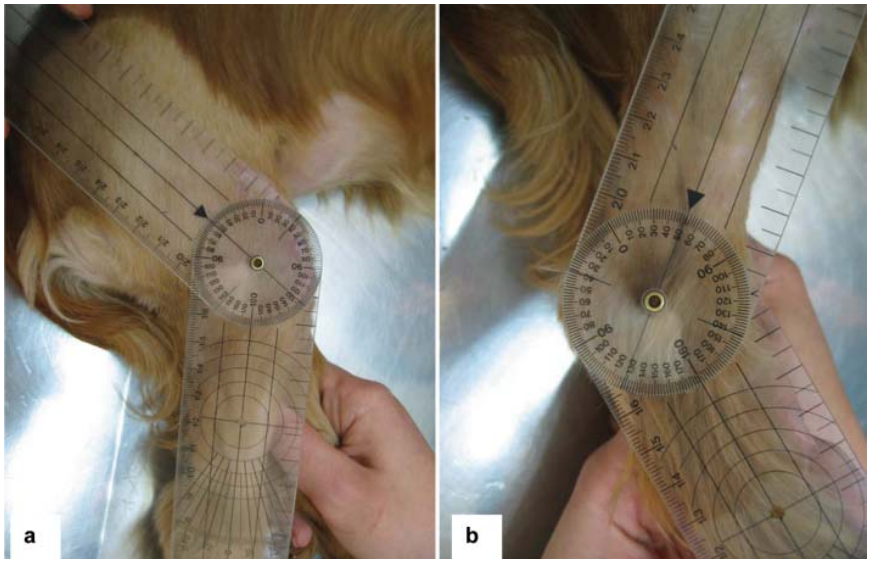

Fig 7. Postoperative clinical views of measurement of joint angles for stifle **(a)** and hock joints **(b)** with a goniometer in case no: 9

Şekil 7. Olgu no: 9'da postoperatif diz **(a)** ve tarsal **(b)** eklem açılarının goniometre ile ölçülmesine ilişkin klinik görünümler

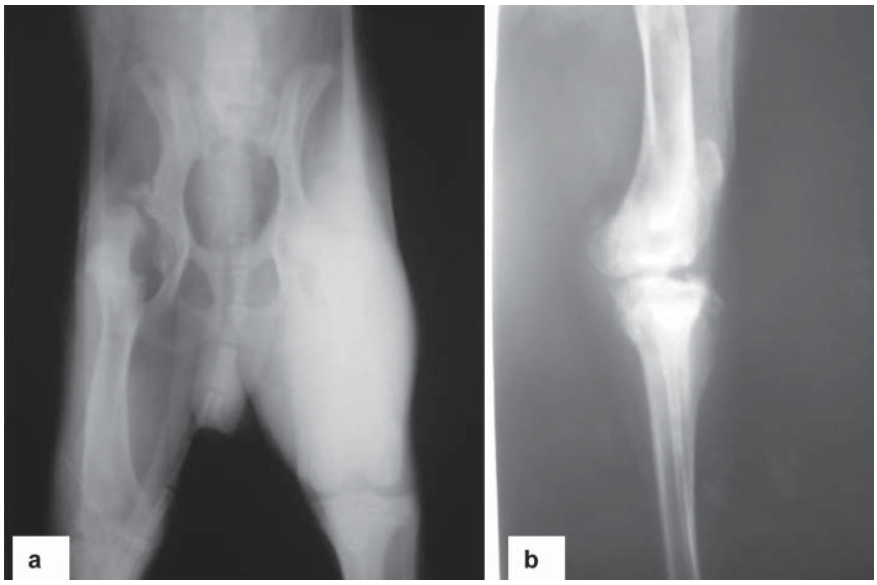

Fig 8. Preoperative ventrodorsal (V/D) **(a)** and mediolateral (M/L) **(b)** radiological views of case no: 11

Şekil 8. Olgu no: 11'in preoperatif ventrodorsal (V/D) **(a)** and mediolateral (M/L) **(b)** radyografik görünümü

Fig 9. Clinical views of right stifle joint on preoperative **(a)** and postoperative **(b)** 7th day of case no: 11

Şekil 9. Olgu no: 11'in sağ diz ekleminin preoperatif **(a)** ve postoperatif **(b)** 7. gündeki klinik görünümleri

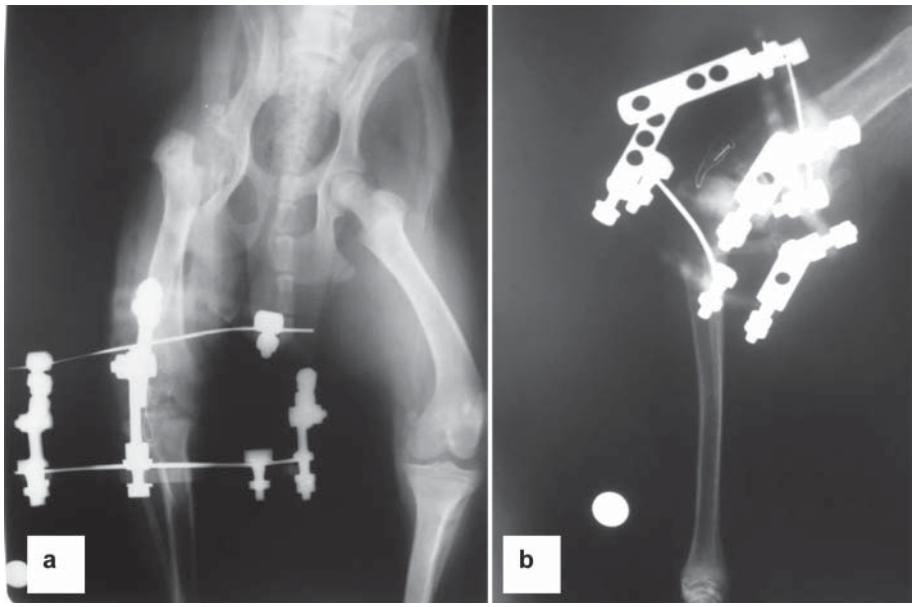

Fig 10. Postoperative radiological ventrodorsal (V/D) **(a)** and mediolateral (M/L) **(b)** views of case no: 11

Şekil 10. Olgu no: 11'in postoperatif ventrodorsal (V/D) **(a)** ve mediolateral (M/L) **(b)** radyografik görünümleri

arthritis of stifle, and femoral shortening involved [1,4,15,16]. The prognosis for complete recovery is extremely "poor" and is guarded even for reasonable limb function. Treatment may bring some improvement in gait, but the patient certainly will have residual lameness [2,3,6].

We concluded that QC should be treated as soon as possible, because it gets difficult for regaining of normal motional angle of stifle joint at chronic period [19], however, postoperative treatment probability of QC is decreased. The matter is only not on FQM for QC, however, all muscles and joints of hindlimb, genu recurvatum and patella alta were evaluated together. And then, according to the whole evaluations, it was determined which techniques or combinations of operation procedures [7,8,10,13,14] were indicate for cases with QC.

According to our experiences in this study, isolation of adhesions, "Z" type myoplasty, tibial tuberosity transposition and applying of ESF for preserving of normal flexion angle on stifle joint for 2 weeks period cause increasing of successful treatment on QC. The stifle arthrodesis can be done extremely.

In conclusion that, fractures of distal femoral shaft of juvenile dogs and cats, especially 0-3 month age period, must be treated by the most proper fixation method, a complete rigid fixation must be provided and the bandaging must be removed as soon as possible using the extremity.

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