



Clinical Outcomes of Flexible Hobble Bandaging in Feline Swimmer Syndrome

Ebru ERAVCI YALIN^{1, a}
Zeynep TOL LACALAR^{2, b}
Kemal ALTUNATMAZ^{3, c}

¹ Istanbul University-
Cerrahpaşa,
Faculty of Veterinary
Medicine,
Department of Surgery,
Istanbul, TÜRKİYE

² Istanbul University-
Cerrahpaşa, Graduate
Education Institute,
Istanbul, TÜRKİYE

³ VetAmerikan Animal
Hospital,
Istanbul, TÜRKİYE

^a ORCID: 0000-0002-0941-6745

^b ORCID: 0000-0002-5179-1098

^c ORCID: 0000-0001-9729-0822

The aim of this study is to evaluate the clinical findings, breed distribution, and accompanying orthopedic and skeletal deformities in cats diagnosed with swimmer syndrome, and to demonstrate the positive effect of early application of the flexible hobble bandage on recovery in terms of treatment and prognosis. This study includes 21 cats presented to the Department of Surgery, Faculty of Veterinary Medicine, Istanbul University-Cerrahpaşa, between 2019 and 2024. The ages of the cats ranged from 20 days to 4 months. Following general, orthopedic, and neurological examinations, swimmer's syndrome was diagnosed. Radiographic imaging was performed to evaluate the presence of thoracic deformities and hip abnormalities. A flexible hobble bandage, made from elastic, self-adhesive tape, was applied to the cats, and its effect on the transition to normal ambulation was assessed. In all 21 cats included in the study, swimmer syndrome was observed exclusively in the hind limbs. In four cases, treatment could not be continued or follow-up was not achieved. Radiographic examinations revealed bilateral hip dysplasia in two cases, thoracic flattening in one case, and pectus excavatum in another. Normal ambulation was achieved within 14 to 45 days following the application of the bandage. The prognosis of swimmer syndrome depends on several factors, including the timing of diagnosis, the presence of concurrent deformities, and compliance with treatment. Early implementation of the flexible hobble bandage and physiotherapy protocols allows for the development of individualized treatment approaches according to the severity of the syndrome.

Key Words: Cat, swimmer syndrome, hindlimbs abduction, flexible hobble bandage

Kedilerde Yüzücü Sendromunda Esnek Hobble Bandaj Uygulamasının Klinik Sonuçları

Bu çalışmanın amacı, yüzücü sendromu tanısı konulan kedilerin klinik bulgularını, ırk dağılımını, eşlik eden ortopedik ve kemik deformitelerini değerlendirmek, tedavi ve prognoz açısından erken dönemde uygulanan esnek hobble bandajının iyileşme üzerine olumlu etkisini ortaya koymaktır. Bu çalışma, 2019-2024 yılları arasında İstanbul Üniversitesi-Cerrahpaşa Veteriner Fakültesi Cerrahi Anabilim Dalı'na getirilen 21 kediyi kapsamaktadır. Kedilerin yaşları 20 gün ile 4 ay arasında değişmektedir. Genel, ortopedik ve nörolojik muayeneleri yapılarak yüzücü sendromu tanısı konuldu. Göğüs deformitesi ve kalça problemi varlığını değerlendirmek için radyografik görüntüleme gerçekleştirildi. Kedilere elastik, kendiliğinden yapışkan bant ile esnek hobble bandajı uygulandı ve normal yürüyüşe geçişe etkisi değerlendirildi. Çalışmaya dahil edilen 21 kedinin tamamında yüzücü sendromu sadece arka ekstremitelerde gözlemlendi. Dört olguda tedavi devamı ve takibi sağlanamadı. Radyografik incelemelerde 2 olguda bilateral kalça displazisi, bir olguda toraks düzleşmesi ve 1 olguda ise pektus ekskavatum saptandı. Kedilerde bandaj uygulamasından itibaren 14 ile 45 gün içinde normal yürüyüş gözlemlendi. Yüzücü sendromunun prognozu; tanının zamanlaması, eşlik eden deformitelerin varlığı ve tedaviye uyum gibi faktörlere bağlıdır. Erken dönemde başlanan esnek hobble bandajı ve fizik tedavi protokolleri ile sendromun şiddetine göre de bireysel tedavi protokolleri geliştirilebilir.

Anahtar Kelimeler: Kedi, yüzücü sendromu, arka bacak abduksiyonu, esnek hobble bandajı

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Introduction

Swimmer syndrome is a developmental disorder observed in neonatal puppies and kittens during the first weeks of life and is characterized by delayed ambulation and impaired motor development. In most cases, the condition does not present with a distinct congenital anomaly; rather, affected animals exhibit abnormal abduction of the hind limbs and, less frequently, the forelimbs (1-3). This abnormal limb posture is primarily associated with hyperflexion of the bilateral coxofemoral joints in the hind limbs, combined with hyperextension of the stifle (tibial-patellofemoral) and tibiotarsal joints. When the forelimbs are involved, affected animals are unable to elevate the cranial portion of the body, resulting in dorsoventral compression of the thorax, abdomen, and pelvis (2, 3). Consequently, animals with swimmer syndrome typically demonstrate a characteristic swimming-like gait, particularly when moving on smooth or soft surfaces (4).

Despite being well described clinically, the exact etiology of swimmer syndrome remains unclear. Several theories suggest a multifactorial origin involving genetic predisposition—such as altered neuromuscular synaptic function—as well as environmental and management-related factors, including slippery flooring conditions.

Correspondence

Ebru ERAVCI YALIN
Istanbul University-
Cerrahpaşa,
Faculty of Veterinary
Medicine,
Department of Surgery
Istanbul – TÜRKİYE

ebueravci@gmail.com

Nutritional imbalances, particularly excessive protein intake during pregnancy or lactation, obesity, maternal metabolic disorders, and low litter size have also been proposed as contributing factors. In addition, developmental abnormalities of the musculoskeletal system and neurological disorders, such as lower motor neuron disease or anterior horn neuropathy, have been implicated in the pathogenesis of the condition (2-10).

Swimmer syndrome may be associated with a range of concurrent abnormalities, including pectus excavatum, medial patellar luxation, joint deformities such as genu recurvatum, and physiological cardiac murmurs (1, 2, 5, 7-9, 11-13). Diagnosis is primarily based on clinical history and physical examination findings, while radiographic evaluation is useful for identifying concurrent skeletal malformations and excluding other orthopedic conditions (2, 5, 6).

Although no standardized treatment protocol has been established for swimmer syndrome (3), conservative management strategies—including bandaging techniques, physiotherapy, and limb immobilization—have been reported to result in favorable outcomes, particularly when initiated early in life (2, 3, 6). Historically, euthanasia has been considered in severe cases due to concerns regarding prognosis (1); however, increasing evidence suggests that early intervention can lead to substantial functional recovery.

The aim of the present study is to describe the clinical characteristics, management, and outcomes of cats diagnosed with swimmer syndrome and to evaluate the effectiveness of early treatment using a flexible-hobble bandage technique, which is simple to apply and may significantly improve functional recovery and quality of life in affected kittens.

Materials and Methods

Research and Publication Ethics: Ethical approval was not required for this study, as all procedures were limited to routine clinical diagnostic and therapeutic interventions. This was formally confirmed by the decision of the Istanbul University-Cerrahpasa Animal Experiments Local Ethics Committee (Decision No. 2024/108, dated 27 December 2024), in accordance with Article 8(k-1) of the Regulation on the Working Procedures and Principles of Animal Experiments Ethics Committees (Official Gazette No. 28914, dated 15 February 2014).

Study Population and Case Selection: This retrospective study included 21 client-owned cats presented to the Istanbul University-Cerrahpasa Faculty of Veterinary Medicine, Department of Surgery, between 2019 and 2024. According to owner-reported histories, none of the other littermates of the included cats exhibited clinical signs consistent with swimmer syndrome.

Cats were enrolled in the study based on a clinical diagnosis of swimmer syndrome, defined by an inability to rise from the ground, marked lateral abduction of the

hind limbs, and failure to develop a normal gait pattern. The onset of clinical signs during the neonatal or early juvenile period was considered a prerequisite for inclusion. Only cats with normal findings on general physical, orthopedic, and neurological examinations were included in the study. Cats showing evidence of primary neurological disease, traumatic injury, or systemic disorders that could account for the observed gait abnormalities were excluded.

Clinical and Radiographic Examination: All cats underwent a standardized clinical examination, with particular emphasis on limb posture, ability to stand, and gait characteristics. Excessive abduction of the hind limbs and absence of a normal gait pattern were consistently observed in all cases (Figure 1).

Radiographic examinations were performed to evaluate the presence of concurrent musculoskeletal abnormalities, including hip dysplasia and thoracic deformities such as pectus excavatum. Hip joints were evaluated on ventrodorsal pelvic radiographs with emphasis on femoral head-acetabular congruity, presence of subluxation, and acetabular depth. Due to the very young age and small body size of the kittens, perfect symmetry in ventrodorsal positioning could not be achieved in all cases; however, the radiographic assessment was considered sufficient for the identification of morphological features consistent with hip dysplasia.

Treatment

Flexible-Hobble Bandage: All of the cases were treated using elastic adhesive bandages (Petflex, Kruuse, Denmark) and elastic fixation bandages (Hypafix, BSN Medical, Germany), applied in an "8" shape. The bandages were positioned over the tarsal joint and distal tibia, and/or metatarsal region, with the legs kept parallel to each other, considering the width of the hips (Figure 3). In Case 6, where there was significant outward rotational pressure at the metatarsal region, an additional hobble bandage was applied to the metatarsal area. This bandaging method was adapted from Verhoeven et al. (2) and Gomes et al. (11). The purpose of this bandaging technique was to address the abduction (sideward movement) of the hind limbs observed during each step and while attempting to stand, and to help the patient adapt to a normal stance position. After the initial bandage application, follow-up examinations and bandage changes were routinely performed on days 5 and 10. Subsequent follow-up intervals were individualized according to clinical progression. The duration of bandage application was not fixed and was determined individually for each case. Treatment success was defined as the achievement of normal weight-bearing, characterized by the ability to stand and ambulate with appropriate limb positioning and without lateral abduction of the hind limbs. Accordingly, the duration of bandaging varied among cases depending on the clinical improvement period. During the treatment period, regular bandage checks were performed; in one case the bandage was renewed due to loosening, and in another case due to

contamination. No bandage-related complications were observed during the bandaging period.

The owners were instructed to encourage the patients to walk during the day. To simulate the natural muscle movements that occur during stepping, light pressure was applied to the hind limbs to facilitate the flexion movement, and the owners helped the patient extend its legs using its own strength. Additionally, the patients' living environments were altered by replacing slippery surfaces with hard, non-slip flooring.

Statistical Analysis: Cases were analyzed using descriptive and non-parametric statistical methods. This study was designed as a retrospective descriptive case series; therefore, no a priori power analysis or sample size calculation was performed. Case inclusion was based on the availability of eligible clinical and follow-up data during the study period rather than predefined sample size targets. The effective sample size was reduced from 21 to 17 cases due to loss to follow-up, which limits the feasibility of robust statistical inference and reduces the generalizability of the findings.

The sex distribution of the included cats was 61.9% (n = 13) male and 38.1% (n = 8) female. Breed distribution consisted of British Shorthair (47.62%, n = 10), Scottish Fold (33.33%, n = 7), and Persian cats (19.05%, n = 4). The mean duration from symptom onset to initiation of treatment was 47.38 ± 31.16 days.

To evaluate factors associated with clinical recovery, correlation and group comparison analyses were performed in an exploratory manner. The relationship between age at treatment initiation (days) and time to treatment completion (days) was assessed using Spearman's rank correlation analysis (Spearman's rho), as the limited sample size and the potential violation of normal distribution assumptions precluded the use of parametric correlation tests.



Figure 1. The pelvic limbs diverted laterally (excessive abduction)



Figure 2. Radiographic appearance of right hip dysplasia, characterized by a shallow acetabulum



Figure 3. Kitten diagnosed with swimmer syndrome treated using a flexible hobble bandage. The bandage was applied in a figure-eight configuration at the tarsal level to prevent excessive abduction of the hind limbs

Table 1. Clinical findings of cats diagnosed with swimmer syndrome

Case No	Age	Breed	Gender	Complaint	Limb Position	Pectus Excavatum/ Thoracic Flattening	Hip Dysplasia	Syndrome Presence in Littermates
1	90 days	Scottish Fold	Female	Unable to rise on hind legs	Hind legs abducted	Thoracic flattening	Right hip dysplasia	No
2	120 days	British Shorthair	Female	Unable to rise on hind legs	Hind legs abducted	X*	Bilateral hip dysplasia	Unknown
3	45 days	Persian	Male	Unable to rise on hind legs	Hind legs abducted	X	X	No
4	20 days	Scottish Fold	Male	Unable to rise on hind legs	Hind legs abducted	X	X	No
5	25 days	Persian	Male	Unable to rise on hind legs	Hind legs abducted	X	X	No
6	30 days	British Shorthair Mix	Male	Unable to rise on hind legs	Hind legs abducted	Pectus excavatum	X	No
7	30 days	Scottish Fold	Female	Unable to rise on hind legs	Hind legs abducted	X	X	No
8	30 days	Persian	Male	Unable to rise on hind legs	Hind legs abducted	Unknown	Unknown	Unknown
9	30 days	Scottish Fold	Male	Unable to rise on hind legs	Hind legs abducted	X	Bilateral hip dysplasia	No
10	30 days	British Shorthair	Male	Unable to rise on hind legs	Hind legs abducted	X	X	No
11	25 days	British Shorthair	Male	Unable to rise on hind legs	Hind legs abducted	X	X	No
12	30 days	Persian	Female	Unable to rise on hind legs	Hind legs abducted	X	X	No
13	25 days	Scottish Fold	Female	Unable to rise on hind legs	Hind legs abducted	X	X	No
14	35 days	Scottish Fold	Male	Unable to rise on hind legs	Hind legs abducted	X	X	No
15	60 days	Scottish Fold	Female	Unable to rise on hind legs	Hind legs abducted	X	X	No
16	60 days	British Shorthair	Male	Unable to rise on hind legs	Hind legs abducted	X	X	No
17	35 days	British Shorthair	Male	Unable to rise on hind legs	Hind legs abducted	X	X	No
18	25 days	British Shorthair	Male	Unable to rise on hind legs	Hind legs abducted	X	X	No
19	90 days	British Shorthair	Male	Unable to rise on hind legs	Hind legs abducted	X	X	No
20	40 days	British Shorthair	Female	Unable to rise on hind legs	Hind legs abducted	X	X	No
21	120 days	British Shorthair	Female	Unable to rise on hind legs	Hind legs abducted	X	X	No

X = No abnormality detected

Results

The study population consisted of 21 cats, including 8 females and 13 males, with ages ranging from 20 days to 4 months at the time of presentation. The breeds represented were Scottish Fold, Persian, British Shorthair, and one British Shorthair mix. Identified

abnormalities included thoracic flattening (1 case), unilateral hip dysplasia (1 case) (figure 2), bilateral hip dysplasia (2 cases), and pectus excavatum (1 case). A summary of the clinical and radiographic findings for all cases are presented in Table 1. Two cases (Cases 1 and 8) did not complete the flexible-hobble bandage protocol; Case 1 discontinued treatment after initial

application, whereas Case 8 did not tolerate the bandage and treatment was not initiated. In addition, two cases (Cases 4 and 7) initiated treatment but failed to continue follow-up and were therefore excluded from further evaluation of treatment outcomes.

Among the cats that completed the treatment protocol, the time required to achieve normal weight-bearing ranged from 14 to 45 days. Treatment was discontinued when stable normal weight-bearing was observed. The age at treatment initiation ranged from 20 to 120 days, and treatment duration varied according to individual clinical response. Detailed case-specific information regarding age at treatment initiation and treatment completion is presented in Table 2.

All cats that achieved normal weight-bearing were followed clinically after treatment completion. When evaluating the duration until treatment completion, four cases for which follow-up could not be ensured were excluded from the analysis. For the 17 cases, the mean duration to complete treatment was found to be 24.94 ± 13.51 days. No recurrence of clinical signs associated with swimmer syndrome was observed in any of the successfully treated cases during the follow-up period. Correlation analysis showed that age at treatment initiation was significantly associated with recovery time. A moderate, positive, and statistically significant correlation between age at treatment initiation and time to recovery (Spearman's $\rho = 0.555$, $p = 0.021$) was found, indicating that recovery time tended to increase in cases in which treatment was initiated at an older age. Statistical significance was set at $p < 0.05$.

Table 2. Ages at the start and completion of treatment

Case No	Age at Treatment Start (days)	Treatment Completion Day
1	90	Did not continue treatment
2	120	45th day
3	45	14th day
4	20	Did not continue treatment
5	25	15th day
6	30	20th day
7	30	Did not continue treatment
8	30	Did not accept treatment
9	30	15th day
10	30	20th day
11	25	20th day
12	30	20th day
13	25	15th day
14	35	15th day
15	60	45th day
16	60	45th day
17	35	15th day
18	25	15th day
19	90	45th day
20	40	15th day
21	120	45th day

Discussion

This retrospective study describes the clinical characteristics, treatment outcomes, and prognostic factors of swimmer syndrome in a case series of 21 cats. The findings suggest that early diagnosis and timely initiation of conservative treatment—particularly the flexible hobble bandage technique—are associated with faster recovery and favorable functional outcomes. In addition, age at treatment initiation appeared to be related to recovery duration, highlighting the potential importance of early intervention in the management of feline swimmer syndrome. Swimmer syndrome has been more frequently reported in dogs; however, the present study confirms that this condition can also be successfully managed in cats when diagnosed early and treated appropriately. Statistical analysis revealed a moderate, positive association between age at treatment initiation and time to recovery, indicating that cats treated at a younger age tended to achieve normal weight-bearing within a shorter period. In the present cohort, cats that began treatment at approximately 45 days of age generally recovered within 14–20 days, whereas those in which treatment was initiated after 60 days of age required up to 45 days to achieve recovery. However, given the moderate strength of the correlation and the retrospective nature of the study, these findings should be interpreted as an association rather than definitive evidence of causality. Swimmer syndrome has traditionally been referred to as “swimmer puppy syndrome” due to its higher prevalence in dogs, but it has also been reported in kittens, pigs, and rabbits (9, 14). Given its occurrence across multiple species, the term “swimmer syndrome” appears more appropriate. In dogs, retrospective studies have reported predominant involvement of the hind limbs (15). Similarly, all cats in our cohort exhibited exclusive hind limb involvement, suggesting possible species-related differences in clinical presentation.

Although a genetic predisposition has been proposed—particularly in brachycephalic dog breeds—definitive evidence remains limited. In cats, breed predisposition has not been clearly established due to the small number of reported cases. In our study, most affected cats belonged to brachycephalic breeds (Scottish Fold, Persian, and British Shorthair), which may suggest a comparable predisposition. However, the absence of affected littermates contrasts with previous reports describing multiple affected kittens within the same litter (11), indicating that genetic factors require further investigation.

Historically, swimmer syndrome has been associated with thoracic deformities such as pectus excavatum, and severe cases were often considered untreatable, with euthanasia recommended (1, 16, 18, 19). Swimmer syndrome and pectus excavatum can occur independently or together (20). Such deformities may worsen prognosis due to secondary complications, including respiratory distress and feeding difficulties (6). In the present study, despite thoracic flattening in one case and pectus excavatum in another, no life-threatening complications occurred, and euthanasia was

not required. These favorable outcomes likely reflect early diagnosis, appropriate owner education, and close clinical follow-up.

Environmental management and supportive care were essential components of successful treatment. Consistent with previous reports, the use of soft, non-slip surfaces was strongly recommended, as slippery flooring has been identified as a contributing factor to disease severity (2, 11). Passive range-of-motion exercises and massage were advised, while dietary modification and complete limb immobilization were avoided to preserve controlled movement and muscle activity.

The flexible hobble bandage technique applied in this study differed from previously described methods that restrict hind limb and lumbar movement (3, 17). Our approach aimed to provide stabilization without completely limiting limb motion, allowing functional muscle activation while minimizing the risk of bandage-related complications. This technique was well tolerated and contributed to favorable outcomes when combined with early intervention.

As a retrospective case series, this study has inherent limitations. The absence of a control group limits causal inference regarding treatment efficacy, and owner compliance with home-care recommendations could not be objectively verified. Nevertheless, ethical considerations precluded withholding treatment in

juvenile animals, and the rarity of swimmer syndrome in cats limits the feasibility of controlled studies. Despite these limitations, the consistent clinical improvement observed in most cases provides valuable practical insight into the management of feline swimmer syndrome.

Finally, owner compliance emerged as a critical factor influencing treatment success. Cases that discontinued treatment or follow-up failed to show improvement, whereas consistent owner involvement and regular monitoring were associated with recovery, even in older kittens. These findings highlight that successful management of swimmer syndrome depends not only on early diagnosis and appropriate treatment but also on effective communication and cooperation between veterinarians and pet owners.

In conclusion, swimmer's syndrome is a condition that can occur in both cats and dogs. In our study, it was most frequently observed in Scottish Fold breed cats. The earlier the syndrome is detected and the earlier intervention is applied, the better the prognosis for the patients. The material and method used for bandaging must be purpose-specific and sufficient. Bandaging and physical therapy protocols can be developed based on the severity of the syndrome, and swimmer's syndrome can be treated effectively.

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