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Effectiveness of Bridle procedure for correction of foot drop syndrome due to peroneal nerve neuropathy

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Abstract

Introduction Foot drop syndrome due to peroneal nerve neuropathy significantly impairs limb support and patient quality of life. The aim of this study was to evaluate the clinical effectiveness of the Bridle procedure compared to ankle arthrodesis and isolated tendon transfer.

Materials and methods A retrospective analysis of 27 patients was performed, divided into a main group ($n = 14$, Bridle technique) and a control group ($n = 13$, arthrodesis or tendon transfer). Functional outcomes were assessed using the AOFAS and VAS scales, along with rehabilitation duration, orthotic use, and complication rates. The mean follow-up period was 2.3 years.

Results The main group showed significantly better outcomes: AOFAS score improved from 38 to 82, VAS score decreased from 6.8 to 2.1, and the need for orthotic devices was reduced. In the control group, improvements were less pronounced (AOFAS: 37→65; VAS: 6.7→3.9). The complication rate was 14.3 % in the Bridle group versus 38.5 % in the control group.

Discussion The Bridle technique restores active dorsiflexion while preserving ankle mobility. Its functional and rehabilitation advantages make it preferable in cases of isolated peroneal nerve injury without severe deformities.

Conclusion The Bridle procedure is an effective joint-preserving surgical method for treating foot drop, providing superior clinical outcomes compared to alternative interventions.

Keywords: foot drop syndrome, peroneal nerve neuropathy, Bridle technique, arthrodesis, tendon transfer, dorsiflexion, rehabilitation.

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INTRODUCTION

Foot drop syndrome is a common disorder most often associated with peroneal nerve neuropathy, one of the most common mononeuropathies of the lower extremity. According to the literature, the incidence of mononeuropathies is up to 15 % of all peripheral neuropathies. Due to the growing number of road traffic injuries, orthopedic surgeries, and the incidence of diabetes, this pathology is becoming increasingly common. It results in unablity to lift the forefoot while walking, leading to a compensatory gait (steppage), poor posture, and decreased stability during movement [1]. Therefore, foot drop syndrome is acquiring high clinical significance and requires the search for functionally effective and joint-preserving surgical correction methods [2, 3, 4]. Foot drop syndrome significantly reduces quality of life, causing limping, difficulty finding footwear, the need for orthoses, an increased risk of falls, decreased physical activity, and social isolation [5, 6, 7]. The rates of using assistive means reflect the severity of the condition; without treatment, patients are often forced to use orthoses or canes [8]. The high incidence of trauma and the prevalence of diabetic and compression neuropathies necessitate the search for effective correction methods, including surgical ones [9, 10].

Peroneal nerve neuropathy is caused by anatomical vulnerability of the nerve in the region of the head of the fibula. The causes of the disease are varied and include trauma, metabolic and compressive effects, iatrogenic factors [11, 13, 14]. The most common antecedents are fractures of the proximal fibula, surgeries on the lower leg and knee joint, and prolonged compression of the nerve. Systemic diseases, including diabetes mellitus and vascular pathologies, play a significant role [6, 15]. In acute injury, surgical treatment is indicated and provides satisfactory results [16, 17]. The pathogenesis of the syndrome is associated with impaired conduction along the motor and sensory fibers innervating the anterior group of leg muscles, which causes loss of dorsiflexion of the foot and toes, as well as decreased sensitivity on its dorsum and the lateral surface of the lower leg. A compensatory steppage-type gait occurs. Without treatment, patients develop muscle atrophy, contractures, and equinus deformity, which significantly impair the weight-bearing function of the limb and require surgical correction [1, 18, 19, 20].

Surgical treatment of patients with foot drop syndrome is aimed at restoring dorsiflexion and improving weight-bearing ability of the limb. Current approaches include arthrodesis, isolated tenodesis, and Bridle reconstruction, each with its own indications and limitations [9, 21]. Arthrodesis provides stability and pain relief by immobilizing the ankle joint, but it impairs mobility and requires long-term rehabilitation; it is used for deformities, arthrosis, and the inability to restore function using soft tissue methods [22, 23, 24]. Tenodesis is a less invasive technique that involves fixation of the anterior tibialis muscle; however, the effectiveness of tenodesis is lower by severe atrophy or the presence of contractures [25].

The Bridle technique is considered the most physiological and functionally sound. It involves reconstruction with transposition of the anterior and posterior tibialis muscles and the peroneus longus muscle, which allows for the redistribution of forces and restoration of dorsiflexion of the foot [26, 27, 28]. Unlike arthrodesis, the Bridle technique helps maintain ankle mobility and, compared to tenodesis, provides more stable and symmetrical movement control [29]. Due to its high efficiency and low complication rate, the Bridle technique is recommended for patients with isolated peroneal nerve neuropathy and preserved foot anatomy.

The **aim** of this study was to evaluate the clinical effectiveness of the Bridle procedure compared to ankle arthrodesis and isolated tendon transfer in surgical treatment of foot drop syndrome.

MATERIALS AND METHODS

The study included 27 patients with foot drop syndrome caused by peroneal nerve neuropathy.

Inclusion criteria: post-traumatic or compression nerve injury with failure to respond to conservative therapy, severe impairment of dorsiflexion of the foot, and intact anatomical structure of the ankle joint.

Exclusion criteria: patients with systemic neurological diseases, diabetic polyneuropathy, severe foot deformities, and severe osteoarthritis.

Patients were divided into two groups: a study group (n = 14), in which the Bridle tendon reconstruction technique was utilized, and a control group (n = 13), which underwent an alternative surgical procedure (ankle arthrodesis or isolated tibialis anterior tenodesis). All surgeries were performed in a specialized orthopedic department, following a standardized protocol for anesthesia and postoperative care. The age and gender distribution of the patients is presented in Table 1.

Table 1

Characteristics of patients

Parameters		Study group (n = 14)	Control group (n = 13)
Males	*n*	8	7
	%	57	54
Females	*n*	6	6
	%	43	46
Age, years		39.28 ± 9.20 (25.9–59.7)	45.49 ± 8.38 (33.0–58.6)

The preoperative examination protocol included a patient medical history, physical examination, plantar ligation, ankle radiography in two projections, electroneuromyography (ENMG), and a consultation of a neurologist.

Foot function was assessed using the American Orthopaedic Foot and Ankle Society (AOFAS) score, and pain intensity was assessed using the visual analog scale (VAS). The average follow-up period was 2.3 years (range, 1.1 to 4.6 years). Outcome assessments were conducted at six weeks, six months, and one year postoperatively, and evaluated functional recovery, pain relief, the need for orthotics, and complications.

The Bridle procedure is an anatomical and functional reconstruction that redirects the strength of the remaining muscles to compensate for the loss of dorsiflexion of the foot due to peroneal nerve injury. The technique utilizes the tendons of the functioning calf muscles (posterior tibial, peroneus longus, and anterior tibial) to create a balanced tri-tendon complex that provides active dorsiflexion and stabilization of the foot in the sagittal and frontal planes.

The surgical approach starts with isolating the posterior tibial tendon, which is transected and brought to the anteromedial aspect of the leg. The peroneus longus tendon is then exposed, mobilized, and also brought to the anterior aspect. Next, the anterior tibial tendon is exposed, and the two structures are sutured into a single bundle. A strong triple suture is created, ensuring balanced tension. Restoration of dorsiflexion of the foot is achieved by redistributing the motor function of the muscles innervated by the intact branches of the tibial nerve. The surgery is performed with careful monitoring of the length and vector of traction, which is crutial for achieving a stable and functionally advantageous foot position.

A distinctive feature of this method is its joint-preserving nature, as ankle mobility is preserved and the anatomical structures are not subject to severe destruction. The postoperative period includes limb immobilization for four to six weeks, followed by a stage of active rehabilitation aimed at restoring muscle control and gait.

Data analysis was performed using Statistica 10.0 (StatSoft Inc., USA). Comparisons between the groups were made based on clinical and functional parameters, such as pain intensity and the need for orthotics.

All patients signed informed consent to participate in the study and to undergo surgical treatment. The study complies with the requirements of the World Medical Association Declaration of Helsinki (2013 edition) and was approved by the institutional ethics committee.

RESULTS

In the study group, where the Bridle method was used, restoration of the support function of the foot and the start of active rehabilitation was as early as six weeks after the intervention. By the eighth month after surgery, the majority of patients (85.7 %) showed significant improvement in function, including restoration of dorsiflexion, gait stabilization, and the elimination of the constant use of orthoses. The average AOFAS score in this group increased from 38.0 ± 6.2 to 82.0 ± 5.7 points, and the pain level on the VAS scale decreased from 6.8 ± 1.1 to 2.1 ± 0.9 points (Table 2).

Table 2

Results of comparison

Parameter		Study group (*n* = 14)	Control group (*n* = 13)
AOFAS	Before surgery	38.0 ± 6.2	37,0 ± 5,9
	After surgery	82.0 ± 5.7	65,0 ± 6,4
VAS	Before surgery	6.8 ± 1.1	6,7 ± 1,0
	After surgery	2.1 ± 0.9	3,9 ± 1,2
No orthotics	*n*	12	5
	%	85.7	38,5
Complications	*n*	2	5
	%	14.3	38,5
Сроки полной реабилитации, мес.		~8	~10

In the control group, which underwent arthrodesis or isolated tenodesis, improvements were also observed, but to a lesser extent. The average AOFAS score increased from 37.0 ± 5.9 to 65.0 ± 6.4 points, while the VAS decreased to 3.9 ± 1.2 points. Eight patients (61.5 %) still required orthotics during prolonged walking or physical activity. The duration of full rehabilitation was, on average, two months longer than in the study group.

Complications in the study group included two cases of minor tendon suture failure without significant clinical symptoms. In the control group, complications were observed in five patients, including limited range of motion, pain in the arthrodesis area, and a poor functional outcome.

The results demonstrate a clear advantage of the Bridle technique over arthrodesis and isolated tenodesis in the treatment of patients with foot drop syndrome. Patients treated with the Bridle technique showed higher functional outcomes (AOFAS), lower pain (VAS), faster recovery, and a lower need for orthoses. They also had a lower complication rate.

Case report

A 50-year-old patient presented with complaints of inability to dorsiflex his right foot, severe lameness, and difficulty in fiiting footware. He had a history of severe traumatic brain injury and orthopedic trauma resulting from a motor vehicle accident. He had previously undergone more than 13 surgeries for multiple femur and tibia fractures, including osteosynthesis, revisions, and reconstructions.

Clinical examination (Fig. 1a) revealed a complete lack of active ankle extension, severe atrophy of the anterior calf muscles, and a compensatory steppage gait. Electromyography (EMG) confirmed irreversible neuropathy of the common peroneal nerve. Conservative treatment proved ineffective. The patient underwent reconstructive surgery using the Bridle technique with the formation of a tri-tendon complex (Fig. 1b). The postoperative period was uneventful. After six weeks, the patient began staged active rehabilitation. By the fourth month, we observed restoration of weight-bearing ability in the limb, and by the eighth month, almost complete restoration of foot function and the elimination of orthoses (Fig. 1c). The functional outcome was 86 AOFAS points and 1 VAS point.

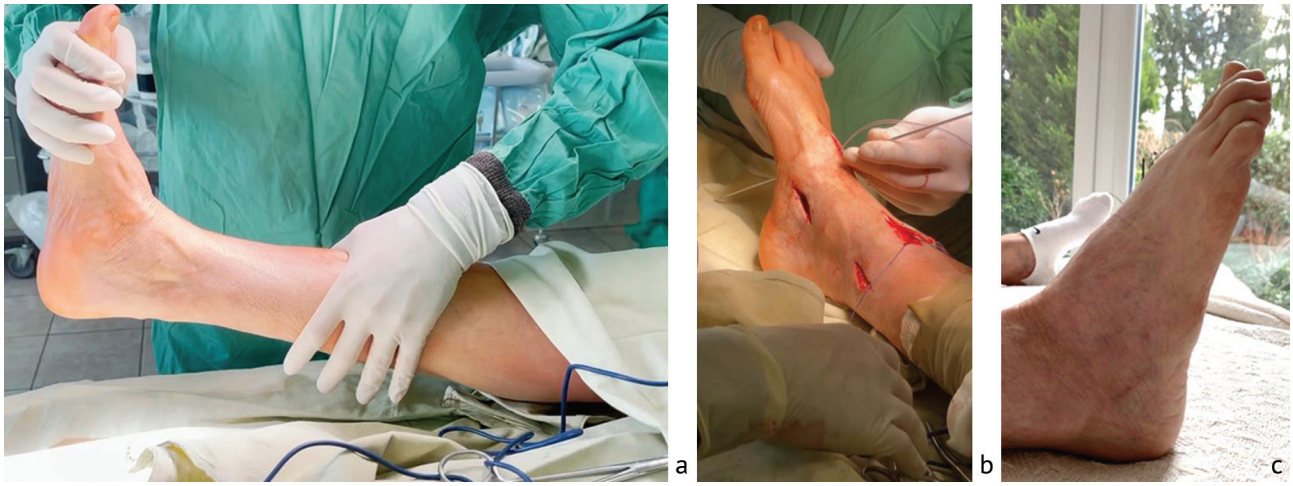

Fig. 1 Photo of the foot in a 50-yo patient with foot drop syndrome: (a) initial view; (b) intraoperative image; (c) at follow-up after 8 months.

Clinical improvement was restoration of symmetrical gait, elimination of compensatory movements, and a significant improvement in the patient's quality of life. Thus, this case confirms the high effectiveness of the Bridle method for isolated peroneal nerve neuropathy with severe functional impairment.

DISCUSSION

The obtained by us results convincingly demonstrate the clinical efficacy of the Bridle procedure in patients with foot drop syndrome caused by peroneal nerve neuropathy. A comparative analysis with traditional surgical approaches (arthrodesis and isolated tenodesis) demonstrated the superiority of the Bridle method across key criteria: restoration of active dorsiflexion, pain relief, shorter rehabilitation time, and no need in orthotic support.

Of particular importance in the Bridle technique is the ability to preserve physiological ankle mobility. While arthrodesis provides mechanical stability, it limits functionality and can lead to overloading of adjacent joints. Isolated tenodesis frequently achieves unstable results, especially in cases of severe muscle atrophy. The joint-preserving nature of the Bridle procedure is particularly relevant for restoring quality of life and reducing disability in working age patients. An additional benefit is the formalization of the pre- and postoperative management protocol, which improves the reproducibility of the approach.

Our data are consistent with the results of international studies confirming the high functional effectiveness of Bridle plasty. In particular, Carolus et al. note that the Bridle technique is effective in cases of isolated peroneal nerve injury and allows for the preservation of ankle joint mobility [10]. Poage et al. point to the preference of reconstructive techniques, especially in patients without rigid

contractures [19]. In the domestic literature, the advantages of the Bridle method have not yet been sufficiently covered; however, the high clinical significance of the restoration of active dorsiflexion and a reduction in dependence on orthoses is noted [3].

Our results differ from some studies due to stricter inclusion criteria: patients with severe deformities, rigid contractures, and systemic polyneuropathy were excluded. This ensured a cleaner sample and increased the predictability of the results.

The main limitations remain the retrospective nature, small sample size, and lack of randomization. Nevertheless, the high reliability of the results is achieved through the use of validated scales (AOFAS, VAS), long-term follow-up (average 2.3 years), and uniform surgical standards.

A protocol for pre- and postoperative patient management has been proposed and tested, which can be used in clinical practice to optimize treatment outcomes. The Bridle technique can be recommended for surgical correction of foot drop in patients with isolated peroneal nerve neuropathy without deformities and with functioning donor muscles. This technique avoids the rigid fixation of the foot typical of arthrodesis and the instability inherent in isolated tenodesis. This method requires further evaluation in multicenter randomized trials with long-term follow-up and analysis of biomechanical parameters.

CONCLUSION

Compared to arthrodesis and isolated tenodesis, the Bridle technique provides better functional results with fewer complications and a shorter rehabilitation period. Based on these results, the indications for this type of intervention have been refined, including preserved foot mobility, absence of rigid deformities, and functioning donor muscles.

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REFERENCES

1. Ewerbeck V, Wentzensen V, Holz F, et al. *Standard procedures in operative orthopedics and trauma surgery*. 3rd ed. Stuttgart: Thieme; 2006:928. (in German)
2. Bowley MP, Doughty CT. Entrapment Neuropathies of the Lower Extremity. *Med Clin North Am*. 2019;103(2):371-382. doi: 10.1016/j.mcna.2018.10.013.
3. Golubeva YuB, Andrievskaya AO, Gorelova IK, et al. Orthopedic services as a tool of medical rehabilitation of patients with foot drop syndrome. *S.S. Korsakov Journal of Neurology and Psychiatry*. 2020;120(10):91-99. (In Russ.) doi: 10.17116/jnevro202012010191.
4. Khizhnikova AE, Klochkov AS, Belova NV, et al. Foot drop: causes, clinical and instrumental diagnostics, and biomechanics. *Nervous Diseases*. 2024;(1):22-30. (In Russ.) doi: 10.24412/2226-0757-2024-13057.
5. Nori SL, Stretanski MF. Foot Drop [Internet]. In: *StatPearls*. Treasure Island (FL): StatPearls Publishing; 2025. Available from: https://www.ncbi.nlm.nih.gov/books/NBK554393/.
6. Novikov AV, Antonova VA. Neuropathy of the peroneal nerve as a complication after total knee arthroplasty: characteristics of rehabilitation. *N.N. Priorov Journal of Traumatology and Orthopedics*. 2020;27(4):41-45. (In Russ.) doi: 10.17816/vto57137.
7. Matsumoto J, Isu T, Kim K, et al. Impact of additional treatment of paralumbar spine and peripheral nerve diseases after lumbar spine surgery. *World Neurosurg*. 2018;112:e778-e782. doi: 10.1016/j.wneu.2018.01.154.
8. Yarikov AV, Makeeva OA, Baytinger AV, et al. Fibular tunnel syndrome: modern principles of diagnosis and treatment. *The Doctor*. 2023;34(11):5-9. (In Russ.) doi:10.29296/25877305-2023-11-01.
9. García-Martínez MÁ, Montejo González JC, García-de-Lorenzo Y Mateos A, Teijeira S. Muscle weakness: Understanding the principles of myopathy and neuropathy in the critically ill patient and the management options. *Clin Nutr*. 2020;39(5):1331-1344. doi: 10.1016/j.clnu.2019.05.027.
10. Carolus AE, Becker M, Cuny J, et al. The Interdisciplinary Management of Foot Drop. *Dtsch Arztebl Int*. 2019;116(20):347-354. doi: 10.3238/arztebl.2019.0347.
11. Desy NM, Wang H, Elshiekh MAI, et al. Intraneural ganglion cysts: a systematic review and reinterpretation of the world's literature. *J Neurosurg*. 2016;125(3):615-630. doi: 10.3171/2015.9.JNS141368.
12. Kretschmer T, Antoniadis G, Braun V, et al. Evaluation of iatrogenic lesions in 722 surgically treated cases of peripheral nerve trauma. *J Neurosurg*. 2001;94(6):905-912. doi: 10.3171/jns.2001.94.6.0905.
13. Huckhagel T, Nüchtern J, Regelsberger J, et al. Nerve trauma of the lower extremity: evaluation of 60,422 leg injured patients from the TraumaRegister DGU® between 2002 and 2015. *Scand J Trauma Resusc Emerg Med*. 2018;26(1):40. doi: 10.1186/s13049-018-0502-5.

14. Westhout FD, Paré LS, Linskey ME. Central causes of foot drop: rare and underappreciated differential diagnoses. *J Spinal Cord Med*. 2007;30(1):62-66. doi: 10.1080/10790268.2007.11753915.
15. Nedosekina MP. Acute neuropathy of the left common peroneal nerve in neurological practice: a clinical case. *Brain Universe*. 2021;3(1[8]):45-46. (In Russ.)
16. Matejcik V, Penzesova G. Surgery of the peripheral nerves. *Bratisl Lek Listy*. 2006;107(3):89-92.
17. Giuffre JL, Bishop AT, Spinner RJ, et al. Partial tibial nerve transfer to the tibialis anterior motor branch to treat peroneal nerve injury after knee trauma. *Clin Orthop Relat Res*. 2012;470(3):779-790. doi: 10.1007/s11999-011-1924-9.
18. Poage C, Roth C, Scott B. Peroneal nerve palsy: evaluation and management. *J Am Acad Orthop Surg*. 2016 Jan;24(1):1-10. doi: 10.5435/JAAOS-D-14-00420.
19. Bao B, Wei H, Zhu H, Zheng X. Transfer of Soleus Muscular Branch of Tibial Nerve to Deep Fibular Nerve to Repair Foot Drop After Common Peroneal Nerve Injury: A Retrospective Study. *Front Neurol*. 2022;13:745746. doi: 10.3389/fneur.2022.745746.
20. Merkulov VN, Imyarov ShD, Dorokhin AI. Tendomuscular transposition in old peroneal nerve injuries in children. *Pediatric Surgery*. 2014;(3):20-22. (In Russ.)
21. Takaishi Y, Okada M, Fujiwara D, et al. Surgical Results of Lumbar Degenerative Disease with Foot Drop. *No Shinkei Geka*. 2019;47(8):851-857. (In Jap) doi: 10.11477/mf.1436204036.
22. Vang Zh, Akhtyamov IF, Ziatdinov BG, Faizrakhmanova GM. Ankle arthrodesis: realities and prospects against the background of new technologies. Literature Review. *Bulletin of Rehabilitation Medicine*. 2022; 21(2): 115-126. (In Russ.) doi: 10.38025/2078-1962-2022-21-2-115-126.
23. Karapinar H, Sener M, Kazimoglu C, Akgun U. Arthrodesis of neuropathic ankle joint by Ilizarov fixator in diabetic patients. *J Am Podiatr Med Assoc*. 2009;99(1):42-48. doi: 10.7547/0980042.
24. Bek D, Demiralp B, Kürklü M, et al. Ankle arthrodesis using an Ilizarov external fixator in patients wounded by landmines and gunshots. *Foot Ankle Int*. 2008;29(2):178-184. doi: 10.3113/FAI.2008.0178.
25. Matsakyan AM, Shirmazanyan AG, Gorochovodatsky AV. Operations on the tendon of the posterior tibial muscle in the treatment of a static flat-valgus deformation. *Vestnik of the Smolensk State Medical Academy*. 2017;16(4):168-177. (In Russ.)
26. Johnson JE, Paxton ES, Lippe J, et al. Outcomes of the Bridle Procedure for the Treatment of Foot Drop. *Foot Ankle Int*. 2015;36(11):1287-1296. doi: 10.1177/1071100715593146.
27. McCall RE, Frederick HA, McCluskey GM, Riordan DC. The Bridle procedure: a new treatment for equinus and equinovarus deformities in children. *J Pediatr Orthop*. 1991;11(1):83-89.
28. Hastings MK, Sinacore DR, Woodburn J, et al. Kinetics and kinematics after the Bridle procedure for treatment of traumatic foot drop. *Clin Biomech (Bristol)*. 2013;28(5):555-561. doi: 10.1016/j.clinbiomech.2013.04.008.
29. Rodriguez RP. The Bridle procedure in the treatment of paralysis of the foot. *Foot Ankle*. 1992;13(2):63-69. doi: 10.1177/107110079201300203.

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