

Clinical and functional outcomes of patients tibiotalar arthrodesis in foot drop treatment

Resultados clínicos e funcionais da artrodese tibiotalar no tratamento do pé caído

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ABSTRACT

Objective: To evaluate clinical and functional outcomes of foot drop with joint degeneration through tibiotalar arthrodesis. **Methods:** We retrospectively evaluated nine patients with foot drop. Of these, two had lumbar disc disease, four had sequelae of poliomyelitis, and three had peroneal nerve injury. All patients underwent open surgery tibiotalar arthrodesis. The functional improvement of the limb were analyzed in the postoperative period. Patients mean age was 45 years and 10 months. Of the sample, six patients were men. **Results:** The American Orthopaedic Foot and Ankle Society (AOFAS) ankle-hindfoot scale, translated and adapted into Portuguese language, were used to evaluate the results. In postoperative assessment, six patients had mild or occasional pain and three did not report pain. The mean AOFAS ankle-hindfoot score was 36, ranging from 26 to 39, and 73 after surgery, ranging from 42 to 91. **Conclusions:** The tibiotalar arthrodesis in patients with foot drop showed satisfactory results, improvement in patients' pain and gait, and, consequently, improvement in their quality of life.

Keywords:

Gait disorders, neurologic/surgery; Arthrodesis

INTRODUCTION

The joints, ligaments, and foot and ankle muscles are designed to promote stability. Foot drop is a condition in

RESUMO

Objetivo: Avaliar os resultados clínicos e funcionais do tratamento do pé caído com degeneração articular, por meio da artrodese tibiotalar. **Métodos:** Foram avaliados retrospectivamente nove pacientes com pé caído, sendo dois com discopatia lombar, quatro portadores de sequelas de paralisia infantil e três com lesão inveterada do nervo fibular. Todos foram submetidos à artrodese tibiotalar por via aberta, e a melhora funcional do membro foi analisada no pós-operatório. A média de idade dos pacientes foi de 45 anos e 10 meses, e 6 pacientes eram do sexo masculino. **Resultados:** Os resultados foram avaliados por meio do questionário da escala do tornozelo e retopé da *American Orthopaedic Foot and Ankle Society Score (AOFAS)*, traduzido e adaptado para a língua portuguesa. Na avaliação pós-operatória, seis pacientes apresentaram dor leve ou ocasional, e três tinham nenhuma dor pós-operatória. A pontuação média da AOFAS para tornozelo e retopé foi de 36 pontos antes da cirurgia, variando de 26 a 39, para 73 pontos pós-cirurgia, com variação de 42 a 91. **Conclusão:** A cirurgia de artrodese tibiotalar em pacientes com pé caído apresentou resultados satisfatórios, com melhora da dor e da marcha, e consequente melhora da qualidade de vida.

Descritores:

Transtornos neurológicos da marcha/cirurgia; Artrodeses

which foot and ankle dorsiflexion and eversion are lost. In affected individuals, plantar flexors act without resistance and leave foot plantar flexor in the phase of balance in the

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gait cycle. Therefore, the forefoot does not leave the floor, requiring great effort from the patient to bend the knees and hip and preventing the foot from touching the floor at this time. The difficulty with ambulating and frequent falls become frustrating and reduce the patient's quality of life.⁽²⁾

The fibular nerve can be injured because of leg fractures, superficial injuries of knee, dislocation in knee adduction, and, during knee surgeries⁽³⁾ the use of a tourniquet near the nerve.⁽⁴⁾ Although the most common cause of foot drop is traumatic injury to the common fibular nerve, other causes, such as injury of the anterior cornus of the bone marrow, lumbar plexus injury, radiculopathy in L5, sciatic nerve injury⁽⁵⁾ and some neuromuscular diseases (eg, Guillain-Barré syndrome and peripheral neuropathies), can lead to this deformity.⁽⁶⁾

Treatment of foot drop includes traditional measures, such as the use of orthosis and functional electrical stimulation of the fibular nerve. Surgery can be performed using dynamic and static techniques.⁽⁶⁾ Dynamic techniques use tendons and muscles transfer. The suture of the nerve (in acute cases) or neurolysis and nerve grafting (in cases of higher evolution) also present promising results.⁽⁶⁾ Static techniques are arthrodesis, osteotomies and tenodesis, which are often used when a dynamic technique fails or are contraindicated in situations such as joint degeneration, neuropathies and brain disease. The main indications for arthrodesis in the ankle are incapacitating pain associated with advanced arthritis (Figure 1), severe instability and angle deformity implicating a functional deficit.

OBJECTIVE

This study sought to evaluate clinical and functional results of treatment of foot drop with joint degeneration by tibiotarsal arthrodesis.

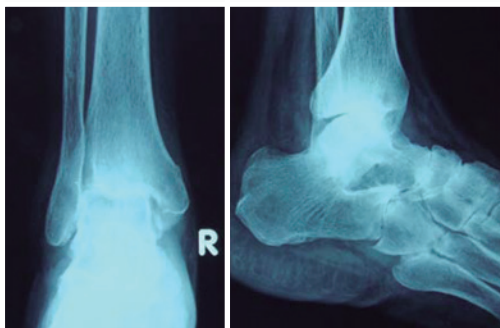


Figure 1 | Radiologic image of patient with ankle arthritis before the surgery.

METHODS

We evaluated nine patients with foot drop. Two of these cases were due to sequelae from lumbar discopathy, four patients had sequelae from childhood paralysis and three had sustained inveterate injury of common fibular nerve. Inclusion criteria were patients with inveterate injury of fibular nerve who had rigid cavovarus foot with equinus deformity, no previous treatment and degeneration of tibiotarsal joint. Patients were excluded if they had abandoned treatment and did not undergo ambulatory treatment.

All patients were performing ambulatory follow-up of foot and ankle surgery at Hospital Santa Marcelina in São Paulo (SP), Brazil. Six patients were men, and the mean age was 45 years and 10 months (range, 33 years and 1 month to 55 years and 3 months).

The same surgical team operated on patients following the tibiotarsal arthrodesis technique with cross-cannulated screws. Only two patients had comorbidities: one female patient had type 2 diabetes mellitus but controlled glycemic indexes, and the other patient had hypertension with acceptable indexes of blood pressure.

Patients' clinical and functional results were retrospectively reviewed after follow-up, which lasted, on average, 22 months. The shortest follow-up was 13 months and the longest was 32 months.

Data were collected for 6 months, from March to August 2013. Clinical and functional results were evaluated by using the American Orthopaedic Foot and Ankle Society (AOFAS) scale, which was translated, adapted and validated for the Brazilian culture. On this scale, the score is composed of nine items divided into three categories: pain (40 points), functional aspect (50 points), and alignment (10 points), totaling 100 points.⁽⁷⁾

Data were entered into Excel spreadsheets and then analyzed by using the statistics program BioEstat, version 5.3. First, we performed statistical analysis by using absolute and percentage frequency. Categorical variables were analyzed with a chi-squared test and Fisher's exact test. Results are presented in tables. The significance level adopted was 5% ($p < 0.05$).

Surgical technique

Patients were positioned in the dorsal horizontal decubitus position under spinal cord anesthesia, with placement of a tourniquet on the thigh. Before the surgery for arthritis with cross screws, we evaluated patients carefully for alignment of normal and abnormal limbs to determine the correct rotation. This can be done by alignment of tibial tuberosity with the second metatarsus.

We carried out an anterior longitudinal incision over the ankle joint and developed the access pathway between tendons of the longus extensor of the hallux and longus extensor of the toes. The nerves and anterior tibial vessels were kept away medially, and the capsule of the anterior tibial edge of the ankle joint was detached.

As an osteotomy and hammer, the joint cartilage was removed from the horizontal surfaces of the tibia and talus, but not from the vertical surface of these bones or the fibula. The ankle position must be around 5° of the valgus, 5° to 10° of external rotation, and in neutral flexus-extension, neutral position or mild posterior deviation of posterior talus in relation to the tibia. For fixation, two or three 7.0-mm cannulated stainless steel screws or 6.5-mm cannulated titanium screws must be used. The first cannulated screw was inserted into the anterolateral surface of the tibia, around 2 to 2.5 cm proximal to the arthrodesis site; the second screw was inserted from the medial surface of tibia, close to midline and anteriorly toward the talar neck (Figure 2).

Eventually, to improve tibiotarsal fixation, a third screw is needed, which passes from the anterior surface of the lateral talar neck directly to the posteromedial tibia.

In all cases, patients underwent enlargement of the calcaneal tendon.

A foam cast boot was used after the surgery. It was exchanged at the end of the first month and continued to be used until the second month. Patients were instructed to continue without weight bearing on the affected foot for approximately, 2 months.

After improvement of pain and edema, physical therapy began with isometric calf exercises. Weight bearing was permitted 2 months after surgery, and exercises were en-

couraged to amplify subtalar movements and strengthen the foot and ankle.

RESULTS

Most patients were men (66.7%); the mean age was 45 years and 10 months, ranging from 33 years and 1 month to 55 years and 3 months. We observed that 44.5% of participants had a previous disease resulting from sequelae of childhood paralysis. We also verified that most patients (44.5%) had had their injury for 11 months at the time of surgery (Table 1).

Of nine patients who underwent surgery (Table 2), six had mild or occasional pain (30 points) and three had no pain (0 points) over 11-month follow-up. Before the procedure, all patients had intense pain with severe limitation for labor activities. None of these patients were excluded or lost to follow-up during the study period.

In relation to passive mobility of ankle flexus-extension (Table 3), all patients had intense restriction of less than 15°, which was the expected result because of the bone fusion.

The remaining functional aspects regarding improvement in performing daily life activities were considerable, with a mean of 36 points after the surgery versus 31 before the surgery, out of a total of 50 points, according to graphic 1.



Figure 2 | Radiologic image of ankle arthrodesis after the surgery for traumatic injury of fibular nerve.

Table 1 | Distribution of patients followed up after ambulatory surgery at Hospital Santa Marcelina, São Paulo (SP), according to the profile

Variables	n	%
Sex		
Male	6	66.7
Female	3	33.3
TOTAL	9	100
Age		
31-45	4	44.4
46-60	5	55.6
TOTAL	9	100
Previous pathology		
Sequelae of lumbar discopathy	2	22.2
Sequelae of childhood paralysis	4	44.5
Inveterate injury of common fibular	3	33.3
TOTAL	9	100
Time of injury at time of surgery (months)		
6 months	3	33.3
9 months	2	22.2
11 months	4	44.5
TOTAL	9	100

The mean AOFAS score of the nine patients in this study improved, from 36 (range, 26 to 39) before surgery to 73 points (range, 42 to 91) after surgery, as can be seen in graphic 2.

The only complication seen in the study was a superficial infection with ulcer on the lateral face of the foot. This infection was treated adequately by using multiple dressing, without loss in the treatment result.

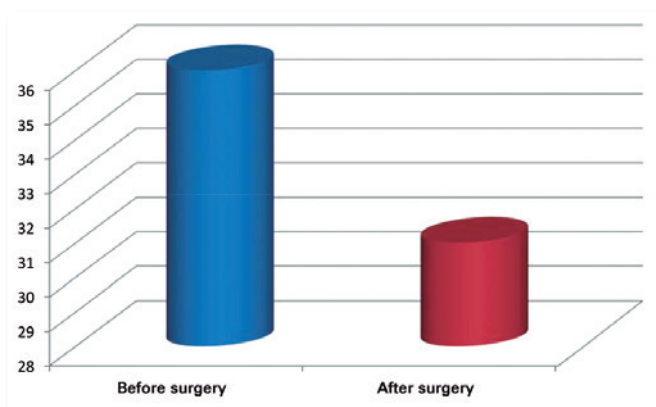
It is important to highlight that three patients in this study used suropodalic orthosis in daily life activities before the surgery because of the sequelae of childhood paralysis. After postoperative rehabilitation, no patients needed to use an orthosis to ambulate.

Table 2 | Distribution of patients followed up after ambulatory surgery of foot and ankle at Hospital Santa Marcelina, São Paulo (SP), according to level of pain

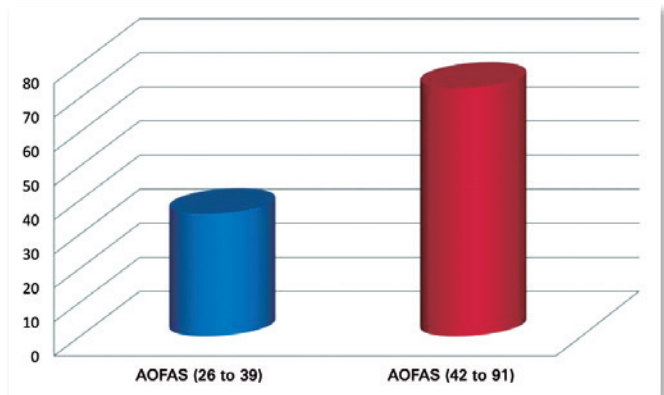
Variables	n	%
Level of pain		
Mil and occasional pain	6	66.7
No pain	3	33.3
TOTAL	9	100

Table 3 | Distribution of patients followed up after ambulatory surgery of foot and ankle at Hospital Santa Marcelina, São Paulo (SP), according to passive mobility of flexus-extension of ankle

Variables	n	%
Passive mobility of flexus-extension of ankle		
Less than 15°	9	100
Greater than 15°	-	-
TOTAL	9	100



Graphic 1 | Distribution of patients followed up after ambulatory surgery of the foot and ankle at Hospital Santa Marcelina, São Paulo (SP), according to functional aspects



Graphic 2 | Distribution of patients followed up after ambulatory surgery of the foot and ankle at Hospital Santa Marcelina, São Paulo (SP), according to AOFAS.

DISCUSSION

Foot drop (Figure 3) worsens patients' quality of life. Surgical options for treatment of foot drop are diverse and are divided into static and dynamic techniques; each has its specific limitations. Tendon transfer for foot drop was described in the literature in 1899 by Codavilla.⁽⁸⁾ Since then, a number of tendon transfer techniques were developed, along with principles created to improve results of surgeries. One of these principles affirms that tendon transfer must have adequate power and excursion. This is because the one transferred muscle often lost a degree of power; sometimes this represents an obstacle for the use of this technique in patients with myelomeningocele and poliomyelitis, which present overall weakening of the leg.

Among static techniques, arthrodesis is highlighted because of its high power of resolution. This surgery produces bone fusion of a joint affected by some type of disease. The deformity is a relative indication for such a technique.



Figure 3 | Patient with traumatic injury of fibular nerve.

Occasionally, an equinus deformity, varus or valgus can interfere with functional activities as much as or more than the pain itself does. Deformity can result from a trauma or neuromuscular disorders. The arthrodesis and realignment, in these cases, can lead to a significant improvement in gait.

Since Charnely introduced the concept of compression arthrodesis of the ankle, more than 30 techniques and many changes have been described. Regardless of the specific technique used, according to Mann⁽⁹⁾, some general principles must be carefully followed. There is the need for contact in juxtaposition of a spongy surface with rigid fixation and good alignment. The ideal position for arthrodesis of the ankle is of neutral flexion-extension with 0° to 5° degree of valgus and 5° to 10° degree of external rotation, and mild posterior dislocation of the talus.

Waters and Mulroy⁽¹⁰⁾ reported on energy expenditure during normal and pathological gait. In normal gait, all the body acts together to minimize changes as much as possible in the center of the gravity in vertical and lateral planes. In the gait of foot drop, other muscle groups are required to keep this center of gravity and raise the affected limb. From these results, it can be seen that arthrodesis of the ankle in patients with foot drop leads to a reduction in energetic gain when compared with the use of one orthosis to ambulate.

Pseudarthrosis occurs in around 10% of cases of ankle fusions recorded and is associated with factors such as severity of initial trauma, neuropathy, infection or smoking. In our study, no patient developed this unpleasant complication. Equinus deformity in varus and internal rotation from bad alignment were not observed in our study.

Three patients included in our study did not present foot drop because of traumatic injury of fibular nerve. Ferraresi et al.⁽³⁾ used electroneuromyography to confirm diagnosis of common fibular nerve injury. According to these authors, after a period of 3 months, with lack of electroneuromyography activity (time need to cure neurapraxia) and clinical signs of foot drop, the diagnosis of nerve fibular injury can be considered. In our study, patients were not eligible for tendon transfer surgery because they had

joint degeneration of the ankle and benefitted from tibiotalar arthrodesis; in three patients who had recorded daily moderate or intense pain after surgery, pain improved (two with no pain [40 points according to AOFAS] and one with mild or occasional improvement in pain [30 points]).

CONCLUSION

Open tibiotalar arthrodesis is a surgical procedure with considerable advantages for treatment of chronic foot drop in patients who are not eligible for dynamic treatment with tendon transfer. Patients had improved quality of life with more physiologic gain, reduction in pain and less energy expenditure, even though they were not satisfied with the aesthetic result of the foot.

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