

Casting a Path to Improved Outcomes: The Crucial Role of Total Contact Corrective Casts in Charcot Neuroarthropathy Treatment

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SUMMARY

Introduction: Charcot's neuroarthropathy is a degenerative disease with an important inflammatory component; it is multifactorial, but a higher prevalence has been observed in diabetic neuropathy. There are several stages and it can occur in every joint of the body, those of the foot and ankle segment are the most functionally and structurally affected; the deformities are closely related to load causing ulcers and sometimes ending in amputations. Treatment is based on modifying the natural history of the disease and reducing the risk of amputation. The Caldiño method is a Charcot treatment algorithm which consists on applying serial total contact corrective casts (TCCC) as a nonsurgical or pre surgical treatment in cases of instability and deformities of the foot and ankle for a period of approximately 3 months.

Objective: To demonstrate the importance of the use of total contact corrective cast (TCCC) as essential element in the treatment of Charcot arthropathy, the application technique and present the casuistry of patients under the use of the Caldiño Method in the hospital during a period of 20 years.

Material and methods: Retrospective review of the casuistry of the Orthopedics Hospital in the foot and ankle service from 2003 to 2023 of patients diagnosed with Charcot neuroarthropathy who were treated under the Caldiño Method for the application of TCCC. A total of 412 medical records of patients seen during this period were identified.

Results: 401 patients with a mean age of 59.5 were included, 68.3% (274 p) were males; the most affected foot was the left (63%). Type 2 diabetes predominated in 85% of the cases,. 54%

of the cases were diagnosed at stage 2 Eichenholtz On average 3 casts were applied, 3.5% of patients presented with minor complications and in 21% the TCCC was used as pre-surgical treatment.

During Follow-up we evaluated the need for reapplication of TCCC or the need for partial support orthosis to achieve an adequate gait.

Discussion: The TCCC is a key procedure in the treatment of patients with neuropathic arthropathy if used in a timely manner, as it maintains an aligned foot, free of contact pressure deformities during the unloading stage of treatment. In patients with significant and unstable deformities that require surgical treatment, the use of pre surgical TCCC showed good bone preservation, small bone resections during surgery or the possibility of performing minimally invasive surgeries.

Conclusions: In our experience, the use of total contact corrective casts following the Caldiño method is an essential procedure for treating patients with long-standing diabetic neuropathy and advanced stages of Charcot neuroarthropathy.

I. INTRODUCTION

Charcot's Neuroarthropathy is a degenerative disease with an important inflammatory component, which responds to load, resulting in articular dislocations and bone fragmentation. Various stages were described by Eichenholtz and its modification allows us to give the appropriate treatment to each one (1-3). The topographic description described by Sanders allows us to perform different forms of immobilization and surgical treatment (4).

Secondary to the epidemiological transition, the etiology of neuropathic arthropathy has changed from being due to infectious diseases (leprosy, later syphilis) to chronic degenerative metabolic diseases. Diabetes is currently the leading cause of Charcot neuroarthropathy. The National Health and Nutrition Survey (ENSANUT 2022) estimates that the prevalence in Mexico of alterations in glucose metabolism is 22.1%, diagnosed diabetes 12.6% and undiagnosed 5.8% (5,6). Worldwide, the prevalence of diabetic neuropathy is estimated at 26% (7) and Charcot neuroarthropathy at 0.8 to 7.5% (8). Alcoholism has been associated as another cause whose national prevalence is 20.6% in adolescents and 55.5% in adults (9). The natural history of the disease has taught us that it is a multifactorial disease, and its treatment must be multidisciplinary.

Neuroarthropathy can occur in all joints, those of the foot and ankle segment are the most functionally and structurally affected; the deformities are closely related to load causing ulcers and sometimes the need for amputation. The Caldiño method is a Charcot treatment algorithm which consists of applying serial total contact corrective casts (TCCC) as a nonsurgical or pre surgical treatment in cases of instability and deformities of the foot and ankle for a period of approximately 3 months.

The TCCC brings together the treatment concepts dictated by several specialists treating other diseases, Khan and Brand unloaded the affected foot for the treatment of foot pathology related to leprosy, Lozano Platonoff used a cast to treat plantar ulcers and weight unloading, Ponseti uses serial casts in order to achieve peritalar alignment. (1, 2, 12-16).

The TCCC is a suropodalic cast that balances extrinsic forces with a neutral ankle, which is placed taking care of the double helix of the foot, favoring its longitudinal and transverse arches and covering the toes, whose objectives are to achieve a plantigrade foot, anatomically congruent, compatible with standing and walking (10) by avoiding support, reducing edema, forced immobilization of the affected segment, improving the autonomic system, balancing the

extrinsic and intrinsic forces of the foot, correcting deformities, closing wounds, aligning the extremity that allows less aggressive corrections and mainly to preserve as much bone as possible when preparing the arthrodesis. This is placed one week after diagnosis and prior use of the Jones bandage.

The description of the technique is exemplified in image 1.

With the patient sitting on the examination table at maximum height, the doctor seated in front of the patient performs the evaluation of the pressure points at the malleolus and sole, looking for skin lesions that suggest areas of greater pressure. Alignment of the limb is observed through gentle maneuvers and reduction of deformities are performed. The skin is adequately lubricated, pressure points are reassessed prior to applying the cast and once the skin is clean and in good condition, a 15 cm cellulose wadding bandage is placed. from distal to proximal in such a way that it covers and protects the toes; a second bandage of cellulose wadding is placed from proximal to distal to achieve partial correction of the deformities. Then a lateral and medial cut is made on the proximal edge of approximately 2 cm, from this point, the placement of the plaster of Paris is started from proximal to distal, leaving the ankle in neutral and reinforcing the correction made when placing the second wadding. It is important to keep an eye on previous crossings at ankle level. The second cast allows us to carry out a greater reduction of the deformities through crossings in the areas that need to be reinforced and the third cast maintains the reduction and covers the toes. The reduction position is maintained during setting. While we smoothen the surface, the areas of reduction of the deformity are molded, the alignment of the hindfoot is monitored and the medial longitudinal arch and the anterior arch of the foot are shaped as far as possible, it is frequent that the first cast does not allow major corrections. Once molded, the cast is smoothed until it has completely set, after 4 weeks it is removed, the foot is cleaned, and the same procedure is carried out every month for a period of 3 months (10).






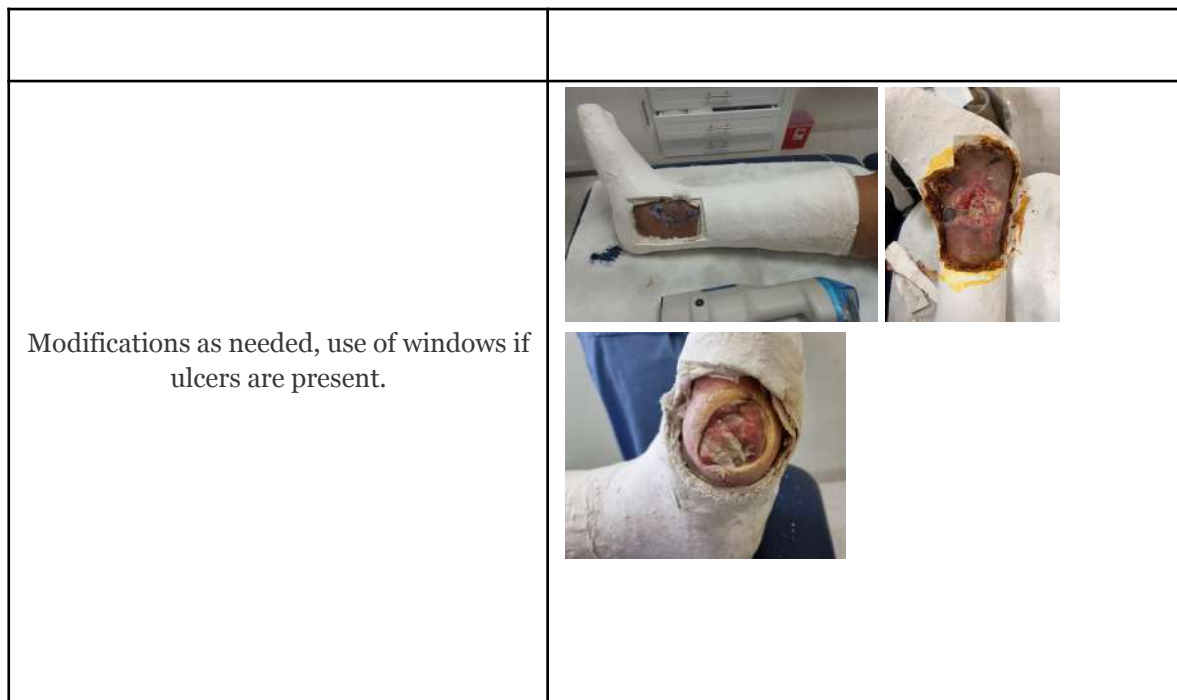
<p>Cotton wadding dressing technique</p>	 <p>Colocamos guata a algodón</p> <p>Segunda guata para corregir deformidad, de proximal a distal</p>
<p>Placement of second bandage to correct deformity from proximal to distal. Placement of plaster bandage from proximal to distal</p>	 <p>Se coloca yeso de proximal a distal</p> <p>Se coloca segundo yeso y</p>
<p>Hindfoot and forefoot alignment maintaining the medial arch</p>	 <p>Moldeamos la alineación del retropié, y nuestro antepié, conservando el arco medial</p>
<p>Smoothing the plaster until it sets.</p>	
<p>Xray</p>	 <p>OYOBALD</p> <p>C.APOYO</p> <p>C.APOYO</p> <p>C.APOYO</p>

Figure 1: Description of the technique used in the Caldiño Method for applying total contact corrective casts (TCCC)



Total contact corrective plasters undergo modifications based on the concepts of the Trueta cure to treat infections (17), in case of presenting wounds, areas at risk or ulcers, a cut is made to the plaster (window) in the affected area that allows wound healing techniques and vigilance. It is important to preserve the cover to avoid edema.

Table 1: Differences Between Total Contact Plaster and Total Contact Corrective Plaster With the Caldiño Method

Total contact cast TCC	Characteristic	Total contact corrective cast TCCC
Discharge ulcer closure	Aim	Align deformities and unload weight
No	deformity correction	Yes
Weekly	Change	Monthly
Yes	Windows for healing	Yes
Undefined	Use time	3 months
Yes/partial/No	Support	No
No	Preoperative use	Yes
Infection, ulcers at other sites, bone loss, shortening of the limb.	Complications	Digital lesions due to moisture and periungual pressure in the lesser fingers.

II. MATERIAL AND METHODS

A retrospective review of the cases of the Orthopedic Hospital in the foot and ankle service from 2003 to 2023 of patients diagnosed with Charcot neuroarthropathy who were treated under the Caldiño Method (evaluated and authorized by the research committee) for the application of total contact corrective cast.

The objective of the present work is to describe the importance of the use of the total contact

corrective cast (TCCC) in the treatment of Charcot’s neuroarthropathy, the application technique and describe the casuistry of patients under the use of the Caldiño Method in the Orthopedics Hospital during a period 20 years.

412 patients with CN attended during this period. Patients with a minimum follow-up of 3 months, with a clinical diagnosis of Charcot Neuroarthropathy (longstanding edema, painless or with mild pain, erythema); history of diabetes,

alcoholism, HIV, liver disease, myelomeningocele sequelae or neurological disorders were included. and radiographic changes (edema in soft tissues, joint diastasis, atypical fractures and fragmentation) who accepted treatment with the Caldiño method. Patients who were not treated with the Caldiño method were excluded.

III. RESULTS

Of the 412 identified cases, 11 patients who were not treated with the Caldiño method were excluded, leaving a total of 401 patients (Table 2) with a mean age of 46.1 years +/-12 years, the male gender being the most affected in a 68.3%

Table 2: Characteristics of the Patients treated under the Caldiño method*

Age (years)**	46.1 +/- 12.1 (24-94)
Gender	Man
Women	
274 (68.3%)	127 (31.7%)

* n (%) **Values expressed as mean and standard deviation (range)

Surgical treatment was performed with arthrodesis, different techniques depending on the stage, joints involved and deformity.

Complementary management of post-cast conservative treatment was performed with assisted gait with a walker and long pneumatic boot for one month, use of insoles and comfortable commercial shoes at week 16 on average. The rehabilitation program begins on the day of diagnosis focused on improving mobility and muscle strengthening, strengthening the contralateral limb and glycemic control, as well as psychological and social support. The follow-up of the patient is clinical and is complemented with blood work up and x-rays. Currently, in cases where there is controversy to start loading, a simple magnetic resonance is taken and evaluated with the Balgrist scale. Surgical cases are planned at the second cast change.

IV. DISCUSSION

TCCC is characterized by deferring support through aligned immobilization as a treatment for neurotraumatic origin where weight bearing in inflamed tissue causes deformities and bone destruction.

(274 patients); the most affected foot was the left for both sexes (63%). Type 2 diabetes mellitus predominated in 85% of the cases, the average time of evolution of diabetes mellitus was 17.2 years until seeking medical attention for Charcot arthropathy. 54% of the cases were diagnosed with Eichenholtz Stage 2 at their first visit.

On average, 3 plaster casts were placed and there were 14 patients with complications attributed to the total contact corrective cast, which represented 3.5% of the population attended and 84 cases (21%) the total contact corrective plaster was used as pre-surgical preparation.

Although the literature describes the use of total contact casts for the treatment of diabetic foot with plantar ulcers, not used to deformities corrections like TCCC does. Different authors describe unloading the weight with a total contact cast as the treatment of choice, they complement the treatment with orthoses, insoles, and appropriate footwear. (18-20).

Time of immobilization according to the literature is said to be at least double of what a patient without diabetes would need. In our study time of immobilization was 3 months +/- 2 months, which is consistent with the average reported in the literature in order to go through all phases of the disease. As described Petrova measured C reactive protein, TNF's and IL6 levels after 3 months of treatment with casts and found lower levels after this time. (21). Virna Zampa use a contrasted MRI determined that the rate of contrast medium uptake occurred during acute inflammatory phase a lasting 3 months. Not all patients can perform it due to the presence of renal disorders, allergies and the high cost. (22) Martin C. Berli describes the use of simple MRI to which the Balgrist scale is applied to predict the immobilization time 3 months or more (23).

Different diagnostic methods have been described, but clinical presentation and physical exploration remain the gold standard for patient follow up and diagnostic.

Cutaneous thermography has been used (2) but in our study we only found it helpful in stages I and II identifying a difference in these stages but normalizes after the first cast and showed no difference in stages 0 and III.

There is no definite evidence that the use of antiresorptive (alendronate, pamidronate, zoledronate, calcitonin, PTH, denosumab) reduces the immobilization time required (2,12) for this reason it is not included in the Caldiño Method.

According to the statistics obtained, the total contact corrective cast is considered an essential procedure in the treatment of patients with neuroarthropathy, as it allows an aligned foot, free of pressure deformities if used in a timely manner with unloading periods of time. In the case of patients with significant and unstable deformities that require surgical treatment, the use of total contact corrective cast allows for bone preservation, small bone resections or minimally invasive surgeries.

To treat a patient with Charcot's Neuroarthropathy you must take into consideration social and familiar factors to identify risk factors which have led to the actual state of health and to be able to create a support network in the treatment.

V. CONCLUSION

The total contact corrective cast TCCC is useful in the treatment of Charcot's Arthropathy during its 4 stages, whether it is conservative or pre surgical treatment.

Its objective is to maintain alignment and balance extrinsic and intrinsic forces of the foot to reduce the deformity and obtain a plantigrade foot, in cases where surgery is needed, TCCC favors to conserve bone stock, handle minor deformities and sometimes use minimal invasive techniques.

Every treatment must be complimented by nutritional, rehabilitation, psychological and medical consults to obtain the best results.

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