NORTHERN OHIO FOOT & ANKLE FOUNDATION

The Northern Ohio Foot and Ankle Journal *Official Publication of the NOFA Foundation*

Conservative Care of the Sub-Acute and Chronic Charcot Deformity

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The Northern Ohio Foot and Ankle Journal 1 (1): 1

Abstract: Charcot Arthropathy is a complex deformity which remains difficult for the physician to manage through all stages. Management of this acute and chronic disorder initially involves a period of non-weight bearing with the goal of transitioning to an accommodative weight bearing device. Determining when to transition the patient, as well as choosing the correct accommodative device can be challenging for the physician. Presented below is a review of the conservative management of the subacute and chronic Charcot deformity as it pertains to timing, the importance of offloading, and selecting the proper accommodative device based on the location of the deformity.

Key words: conservative, Charcot, sub-acute, chronic, accommodative device

Accepted: October 2014 **Published:** October 2014

Transitioning from the acute stage of Charcot to the chronic stage of Charcot is vitally important in preventing progression of the deformity or reactivation. However, this can be difficult for the clinician to determine the best time to do so. Classically patients are non-weight bearing for 8-12 weeks in total contact cast (TCC) during the acute stage and then transitioned to protective weight bearing in a Charcot Restraint Orthotic Walker (CROW) device or removable cast walker for another 4-6 month[1]. Finally, depending on the severity and location of the deformity, patients can move to full weight bearing in an accommodative device.

The time table to transition the patient to a long term protective device is highly variable. The clinician needs to base their decision on both clinical and radiographic findings rather than a strict timeline. Clinically, a reduction in edema, erythema and a temperature difference of less than 2 degrees Celsius compared to the contralateral limb indicates the start of the quiescent phase[1]. Radiographically, the clinician should look for signs of the coalescence or reconstruction phase such as absorption of debris, sclerosing, joint fusion and new bone formation[1]. In cases where these findings are equivocal, it has been suggested magnetic resonance imaging (MRI) may aid in determining the progression to the sub-acute or chronic phase[2].

Offloading Principles

The goals of offloading in the sub-acute and chronic phase should be similar, the only difference will be in the device used to do so. These goals should include preventing further collapse of the deformity, reactivation of the acute phase, prevent ulceration,

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should be relatively cost effective and have high patient compliance[3]. The latter might be the most important aspect in achieving these goals. Devices that are relatively comfortable, less bulky and are easy to use will lead to higher patient compliance.

Offloading in these patients who develop Charcot will be pivotal in reducing the associated high morbidity and mortality that accompanies this condition. Rith-Najarian et al demonstrated that diabetics with neuropathy and foot deformities are twice as likely to developing ulceration[4]. Several studies have investigated the risk of ulceration after developing Charcot which ranges anywhere between 37-67%[5,6,7]. The relatively high occurrence of ulceration may partly be due to significantly higher peak pressures seen in these patients. Armstrong et al demonstrated that patients with Charcot have significantly higher peak pressures than patients with neuropathy alone. The differences between the two groups were 100 newtons per square centimeter vs 65 newton's per square centimeter respectively[8]. Finally, diabetics have a significantly greater chance of lower extremity amputation when they develop ulceration versus those diabetics who have no ulcerations[9]. These factors highlight the importance of reducing plantar pressures and preventing potential ulcerations in the high risk Charcot patient.

Offloading devices

The offloading device used varies depending on the severity and location of the deformity[10]. Typically during the sub-acute phase a Charcot restraint orthotic walker (CROW) or removable cast walker should be employed for 4-6 months, and then the patient can be transitioned to an accommodative device for long term management[1]. Mild deformities involving the forefoot and midfoot can be treated with multi-density inserts and custom shoes[11]. Severe forefoot and midfoot deformities may require custom shoes to accommodate the deformity[11]. Hindfoot deformities may require either an ankle foot orthotic (AFO), patellar tendon bearing brace (PTB) or CROW device based on the stability of the deformity[11].

A CROW device is a custom, bivalve, total contact AFO with a custom multi-density insole and a rigid rocker bottom sole[12]. The device simulates a total contact cast while still being removable. Advantages to this device include: better hygiene, edema management, accommodates severe deformities, protected ambulation and allows easy access for wound care when needed[13,14]. The two main disadvantages are the high fabrication cost associated with making and maintaining the device and the bulky nature of the device which can make ambulation difficult for the patient. In a series by Morgan et al, eighteen patients were treated with a CROW device[15]. All patients in the study described the device as good to excellent with improvement in their quality of life. Of the eighteen patients, fourteen patients did not have further recurrence or ulceration, four patients' required further surgery and three patients re-ulcerated. Removable cast walkers (RCW) with custom orthotic inserts have more recently been recommended for protective weight bearing during the sub-acute phase[10]. Their advantages are similar to

Figure 1 Charcot Restraint Orthotic Walker

a CROW device, consisting of a rigid rocker sole for pressure reduction, removable for better hygiene and wound care. RCW have some benefits over a CROW device being that they can be easily dispensed from the office and are less expensive to the patient[1]. However, they have an inherent limitation, as these devices will not be custom for the patient. In patients with the severe rocker bottom deformities these devices may not be as ideal as the CROW device. Verity et al in 2006 investigated the use a RCW in 21 patients with varying stages and locations[16]. At the end of the study, 17/21 (68%) had reached consolidation and were transitioned into a long term orthosis.

Once the patient has reached the consolidation phase, the patient should then be transitioned into an accommodative offloading device. The type and design should be based on the location and severity of the deformity. Custom orthotics are usually recommended for less severe forefoot and midfoot deformities[1, 11, 17]. Accommodative orthotics, through a multi-density layer design, attempt to reduce plantar pressures and shear forces while still stabilizing the deformity. Pressure reduction is achieved through the materials used (i.e. soft plastazote, ppt), as well as through more evenly distributing forces across the entire foot[18]. In addition, by redistributing forces across the entire foot, horizontal movement of the foot is limited, which in doing so helps reduce shear forces[19]. The shell of the orthotic should be rigid and made of either thermoplastic or rigid plastazote. These materials help to support the deformity and reduce abnormal stress and strain across the foot. Kato et al looked at the reduction of plantar pressures in diabetics and found a reduction of plantar pressure by 56.3% while increasing total contact area by 62.7%[20].

Therapeutic shoes are often the mainstay treatment for the mild to moderate forefoot and midfoot Charcot deformities. The ideal therapeutic shoe should be light weight, extra depth, wide in the midfoot, a long medial counter and a shock absorbing out sole. A shoe that's wide in the midfoot not only helps accommodate the deformity but also increases the contact area with the ground helping to further reduce plantar pressures. There are endless modifications that can be added to help reduce plantar pressure including medial or lateral heel flare, metatarsal bar, steel shank, and rocker sole's[18]. Rocker sole's limits the amount of extension that occurs at the metatarsophalangeal joint while preventing anterior migration of the fat pad which helps reduce forefoot pressure[21]. One study investigating using a custom foot orthosis and an extra depth shoe in patients with midfoot Charcot found at one year 59.2% patients were ambulatory and ulcer free[22]. In the severe rocker bottom deformities patients may need custom shoes to accommodate the deformity.

Ankle foot orthotics (AFO) can be used in those patients with mild to moderate hindfoot deformities. They are constructed of thermoplastic material extending from the middle of the calf to just proximal to the metatarsal heads. A custom orthotic should be

Figure 2 Short Articulating ankle foot orthotic

built in and they have the option of being fixed or hindged[23]. Articulating AFO's should be reserved for more mild cases and those that do not involve the ankle joint. Solid AFO's are better suited for moderate unstable hindfoot deformities especially

involving the ankle joint. Benefits to the AFO include reduction in frontal plane stress and reduction in plantar pressure by helping to decelerate the foot when it reaches ground reactive forces. In a small case series using AFO's to heal ulcerations in patients with chronic Charcot, they found an average healing time of 9 weeks with a reduction in plantar pressure to the ulcer site by 70-92%[24].

Finally, in the severely unstable hindfoot deformity the patellar tendon bearing brace is recommended[25]. The patellar tendon bearing brace consists of cuff (either leather or padded molded plastic), metal uprights (fixed or hinged) which attaches to a custom extra depth shoe with a custom insert[23]. The PTB brace reduces plantar pressure by transferring ground reactive forces through the metal uprights to the leg. Fixed PTB braces are better at reducing plantar pressure but are not tolerated by patients as well. Patellar tendon bearing braces are better at reducing plantar pressure to the hindfoot than the forefoot with reduction of plantar pressures reported anywhere between 32% and 90% in the literature[26].

Conclusion

In the high risk Charcot patient close monitoring is necessary in preventing the serious complications that accompany these patients. It is particularly important immediately after receiving a new brace or orthotic as this is the time these patients are at the highest risk for developing new ulcerations[27]. Bracing will depend on the location and severity of the deformity but should be individualized based on the patients need. Finally, there is limited evidence based medicine to guide the clinician in choosing the proper accommodative device. Most of the literature is based on anecdotal evidence and further studies are needed to investigate the ideal offloading device in the Charcot patient.

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