Madras Medical College protocol in the management of diabetic claw toes

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Abstract:
Diabetic neuropathy predisposes numerous complications in the diabetic foot. One of the more common musculoskeletal deformities is claw toes. Based on the pathogenesis of diabetic claw toes, we developed a management protocol comprised of four Grades and associated treatments. Our study focused on whether using the protocol resulted in improved outcomes. Our stratified intervention, by structured protocol, resulted in less than a 1.5% ulceration rate among 6,298 treated toes that were followed-up for 1-year. Our simple grading and easy to follow protocol can be a useful tool in the management of claw toes in the neuropathic diabetic foot.

Key words: Diabetic Toe Ulcers, Intrinsic Minus Feet, MMC Grading of Claw Toes, Neuropathic Diabetic Foot

INTRODUCTION

Diabetic claw toes are one of the most common manifestations of diabetic neuropathy in the lower limb. According to Western data, between 30% to 40% of diabetics have significant neuropathy during their lifetime. Studies conducted at our institute showed that 60% of diabetic patients having diabetes for more than 10 years have neuropathy. We did this study to test the reliability and reproducibility of a grading and treatment protocol that could effectively treat diabetic claw toes. We concluded that using our stratified protocol could make a major impact in toe preservation and subsequent limb preservation mission in diabetics. This is particularly important given the current epidemic of Syndrome X in the South Indian subcontinent.

LITERATURE REVIEW

Pathogenesis of Claw Toes: Intrinsic muscle atrophy underlies the etiology of claw toes, due to the uninhibited action of aldose reductase resulting in sorbitol and advanced glycosylation end product accumulation in both sensory and motor nerves. In diabetic neuropathy, the large motor fibers of the tibial nerve are affected early on. This causes a dynamic imbalance of long flexors and extrinsic extensors which results in a weakness on flexion of the toes at the metatarsophalangeal (MTP) joint. Additional hyperextension at the MTP joints, in association with flexion at the interphalangeal (IP) joints, due to intrinsic muscle atrophy, characterize claw toes deformities.

Because of the associated contracted collaterals and joint degenerative disease, claw toes progressively become rigid deformities with decreased range of mobility in the affected joints. Excessive pressure occurs during weight bearing and walking. Pressure leads to periungual callosities, then later, ulceration, and in extreme untreated cases, absorption of terminal phalanges. This is in contrast to hammer toes, where the fixed extension contracture at the distal interphalangeal joints causes callosities and ulceration at the terminal pulp.
STUDY AIM

The aim of this study was to prevent toe ulceration and loss of toes in early onset diabetic cases by preventing the deformity-related pressure, ulceration, infection, and amputation sequence. In late-stage cases, we sought to eschew “transfer lesions” after amputation by effective stratified management of diabetic claw toes.

MATERIALS AND METHODS

Diabetic patients’ claw toes were first classified into two groups by clinical examination and ankle-brachial indices: 1) those due to neuropathic causes and 2) those due to neuro-ischemic causes. We studied 631 patients during the observational protocol. During the study period, March 2011 to March 2014, we treated 6,298 toes.

INCLUSION AND EXCLUSION CRITERIA

The study inclusion criteria was:

• Diabetics with only neuropathic claw toes
• Patients who, after counseling, demonstrated a motivation to follow the protocol faithfully

The study exclusion criteria was:

• Diabetics with overt Charcot’s degeneration in any foot joints
• Diabetics with noncompliance of instructions, dropouts, and those who developed ischemic changes in a 1-year period

GRADING OF THE SEVERITY

Once enrolled, we then stratified the patients into one of the following four Grades:

Grade 1 (Figure 1): Claw toes are not apparent, but on voluntary flexion of the great toe, the other toes developed claw deformity. No skin changes are observed, and the range of mobility (ROM) is full in all joints. It is only a muscle imbalance stage.

Grade 2 (Figure 2): Claw toes are apparent even at rest. ROM is full in all joints, and skin changes are absent.

Grade 3 (Figure 3): The number of claw toes with ROM are greatly reduced. Periungal callosities are common, but no ulceration is present, but may occur on paring.
Grade 4 (Figure 4): Rigid claw toes that exhibit almost no ROM and ulcerations at the tip (periungual) or at the dorsum are shown. They show infected pseudo bursa with bony involvement.

TREATMENT PROTOCOL

Staff at the Madras Medical College used the protocol devised in our department (Plastic and Faciomaxillary Surgery) to treat the patients based on the degree of severity.

Grades 1&2: Since these are only in the muscle imbalance stage, they were treated by physiotherapy and passive stretching exercises to all joints. We provided locoregional offloading-silicone gel socks with protective footwear (Figures 5 and 6) both for inside and outside home use. Strict instructions were given to remove the offloading devices only during sleeping and retiring to bed.

Grade 3: There were contracted collaterals with contracted volar plates in the IP joints. Paring of callosities can reduce local pressure. Silicone toe caps were given with silicone socks and mild rocker footwear (Figures 7 and 8). If the paring revealed an underlying ulcer, a small dressing was applied and covered by a silicone toe cap. Occasionally, a percutaneous capsulotomy was done at the time of paring. If pain sensation was present, the percutaneous capsulotomy was done under digital block.

Grades 4&5: The contractures were in all the joints. The toes were treated with protected toe caps and mild rocker footwear (Figures 7 and 8). If the paring revealed an underlying ulcer, a small dressing was applied and covered by a silicone toe cap. Occasionally, a percutaneous capsulotomy was done at the time of paring. If pain sensation was present, the percutaneous capsulotomy was done under digital block.
Grade 4: For these stiff, contracted toes, a tenotomy with percutaneous capsulotomies under ankle block were done as a minor operating theater procedure. After global offloading was done for two weeks, silicone toe caps with silicone socks and anterior ortho-wedge footwear were used for six months. Final footwear has a regular mild rocker sole (Figures 9 and 10). If bone was involved with infected pseudobursa, a shortening arthroplasty was performed. Silicone toe caps for adjacent toes to prevent transfer lesions were applied.

Figure 9. Footwear with regular mild rocker soles.

Figure 10. Silicone caps for adjacent toes.

TECHNIQUES OF TENOTOMY

The following describes the steps of the tenotomy.

A. Grade 4 claw toes describes a callosity and pseudo bursa (Figures 11 and 12).

Figure 11. Claw toes with callosity and pseudo bursa.

Figure 12. Another view of claw toes with callosity and pseudo bursa.
B. After the ankle block was done, we did a flexor tenotomy through a 3 to 5mm incision (Figure 13). All long flexors were released. In the hallux, the flexor hallucis longus (FHL) alone was tenotomized at the proximal phalanx level. In lesser toes, all long flexors were divided at the MTP level.

Figure 13. Flexor tenotomy with a 3 to 5mm incision.

C. We identified FHL after opening the fibrous flexor sheath (Figure 14).

Figure 14. Identification of FHL.

D. We then hooked out the long flexor tendon (Figure 15).

Figure 15. Long flexor tendon hook out.

E. After closing the tenotomy site and completing the clean surgery, we proceeded to callus paring (debridement) and pseudobursal excision (Figures 16 and 17).

Figure 16. Callus paring.

Figure 17. Pseudobursal excision.
F. This is the position of the hallux after the tenotomy (Figures 18 and 19).

Figure 18. Position of the hallus after the tenotomy.

Figure 19. Another view of the position of the hallus after the tenotomy.

G. Dressing (Figure 20) and global offloading occurred for two weeks and was then followed by anterior ortho-wedge footwear for six months.

Figure 20. Dressing and offloading.

H. The following shows the post-operative results of the procedures (Figure 21).

Figure 21. Post-operative results of the procedure.
OBSERVATIONS AND RESULTS

Table 1 shows the treatment protocol results, based on deformity Grade, at a 1-year follow-up.

Table 1. 1-year results according to severity grade.

<table>
<thead>
<tr>
<th>Grade of Claw Toes</th>
<th>Number of Patients</th>
<th>Treatment Modality</th>
<th>Ulceration and Recurrence Rate at 1-year Follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 1</td>
<td>103-M86, F17</td>
<td>Physiotherapy and locoregional offloading</td>
<td>No ulceration in toes</td>
</tr>
<tr>
<td></td>
<td>(1030 toes)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 2</td>
<td>110-M90, F20</td>
<td>Same</td>
<td>No ulceration in toes</td>
</tr>
<tr>
<td></td>
<td>(1100 toes)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 3</td>
<td>206-M126, F80</td>
<td>Paring of callosity with excision of pseudobursa with closed capsulotomy followed by offloading</td>
<td>0.5%</td>
</tr>
<tr>
<td></td>
<td>(2054 toes)</td>
<td></td>
<td>(1 great toe ulcer recurrence after 6 months)</td>
</tr>
<tr>
<td>Grade 4</td>
<td>212-M123, F89</td>
<td>Tenotomy closed capsulotomy/amputation preventive silicone capping of adjacent toes to prevent transfer lesions</td>
<td>1%</td>
</tr>
<tr>
<td></td>
<td>(2114 toes)</td>
<td></td>
<td>(2 toes re-ulcerated)</td>
</tr>
</tbody>
</table>

A higher number of Grade 4 ulcers, compared to Grades 1-3 ulcers, occurred at 1-year follow-up (Figure 22).
DISCUSSION

With aging, a Western life style, urbanization, industrialization, and genetic predisposition, we have seen a significant increase in the number of Type 2 diabetic patients. Neuropathy induced deformities pave the way for the cycle of deformity: high pressures > callosity > pseudobursa > infection > bone infection > absorption > gangrene > amputation. Most of our major amputations were precipitated by a toe infection ascending along the extrinsic tendons in the feet. Our grading of claw toes not only provides a standardized approach for comparative studies, but also stratifies treatment for different grades of claw toes severity. Our Grade 1 and 2 deformities show the disease at an early muscular imbalance stage when preventive education, foot care hygiene, offloading with silicone gel socks, mild rocker foot wear, or deep street shoes is used. No recurrent ulceration developed in the study population, 213 patients with 2013 toes, during the 1-year follow-up. In the late disease cases (Grade 3), simple tenotomies and closed capsulotomies were followed by global offloading, and footwear offloading resulting in only 0.5% recidivism within the study period. In late disease cases (Grade 4), our approach was to shorten arthroplasties and perform closure transfers to the pressure points on adjacent toes. Therefore, silicone toe capping could prevent transfer ulcers in the adjacent toes as a part of tertiary prevention. In Grade 4 cases, our ulcer recurrence rate at 1-year was only 1%. Thus, we found that our stratified intervention by a structured protocol resulted in a very low re-ulceration rate in a total of 6,298 toes treated and followed-up for 1-year.

CONCLUSION

This study showed that stratification and grading were simple and could facilitate definitive management in each Grade. Accordingly, our protocol-based management of claw toes in diabetic patients yielded significant clinical results with exceedingly few ulcers developing after 1-year of follow-up. This simple protocol and structured treatment could be adopted by any multispecialty integrated team involved in treating the diabetic foot.

References