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An Innovative Treatment for Florid Cellulitis Leg (Multiple Mini-Fasciotomies - MMF)

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ABSTRACT: A new innovative surgical approach, Multiple Mini Fasciotomies (MMF), is described to hasten resolution of florid cellulitis of leg and foot. Simplicity of the procedure and the prompt favorable response within 12-24 hours, in an apparently hopeless situation, is considered very useful in minimizing the morbidity and complications of sepsis. Though the number of cases (n) is not very large, consistent improvement in all cases who underwent this procedure, is being reported.

INTRODUCTION

Florid cellulitis[3] of leg and foot is a common problem encountered in diabetics, obesity, venous insufficiency, filariasis, immune compromised and those with trophic ulcers [23]. Infected corn or tinea pedis are also known to provide portal of entry to bacteria. It is a spreading infection of subcutaneous, subfascial and intermuscular planes and is so diffuse, without localization, except to give higher antibiotics (empirical)[9,15], at present there is no definitive treatment available[12]. Unless there is ulceration, discharge or aspirated pus (from an abscess), microbiological data is not possible and blood cultures are often unhelpful. Though we have been adopting this surgical technique for more than 15 years, surprisingly with good results, more systematic study and proper documentation were carried out only since 5 years (2020-'25).

MICROBIOLOGY

Cellulitis is caused when bacteria, most commonly β-Hemolytic Streptococcus[2], Staphylococcus and Claustridium perfringens, enter through a break in the skin. Tissue destruction and ulceration may follow, caused by streptokinase, hyaluronidase and other proteases. The incidence of a more serious Methicillin-resistant Staph. aureus (MRSA) is on the rise[10]. Other bacteria rarely responsible are Pseudomonas and Hemophilus groups. Liberal injudicious use of high antibiotics has paved way for developing resistant strains of bacteria, difficult to eradicate[7].

NATURAL COURSE

With the present management, the condition may have several outcomes [19,20,22]:

1. Resolve completely (if effective treatment was started early)

2. Suppuration, producing a deep-seated abscess[8]

3. Avascular necrosis or infective gangrene of the overlying skin, resulting in large ulcers

4. Lead to necrotizing fasciitis

5. Cause life-threatening septicemia, pyemia or endocarditis[11]

6. Go into a state of chronic smoldering inflammation, with persistent edema, warmth and tenderness and risk of eruption (recurrence) of infection at anytime

7. In diabetics, the glycemic control may be difficult and may precipitate ketoacidosis

SYMPTOMS & SIGNS

Unilateral acute painful swelling of leg and foot, associated with fever and chills (due to exotoxins and cytokines) and local warmth and tenderness over the affected area is the typical presentation. Necrotic spots, blisters and features of toxicity are ominous signs of impending gangrene of overlying skin[17]. There may be popliteal or inguinal lymphadenopathy, more often seen in filariasis.

DIFFERENTIAL DIAGNOSES

The condition has to be differentiated from other acute conditions, commonly affecting the leg, such as : deep vein thrombosis (DVT), filarial lymphangitis/lymphedema, compartment syndrome, gas gangrene, eosinophilic (non-infective) cellulitis (Well's syndrome) etc.

Investigations: Besides the routine studies, including those related to co-morbidities, a few inflammatory markers were used to monitor the control of infection.

Inflammatory markers [1]: These are very nonspecific, may indicate the severity of cell damage, with no diagnostic significance, have been used in various inflammatory disorders.

1. Blood total white cell count (TWBC) & differential count, polymorphonuclear leukocytosis with a 'shift to the left', is one of the time-honored indicators
2. Westergren's Erythrocyte Sedimentation Rate (ESR)
3. C-reactive protein (CRP) is a complement-activating protein, promoting phagocytosis by macrophages, to clear necrotic or apoprotic cells, used as an inflammatory marker
4. Antistreptolysin-O (ASO or ASLO, is an antibody against hemolytic exotoxin liberated by Streptococci) titres may be helpful, but the latter may not be useful in the first few days.
5. Creatinine Phosphokinase (CPK) also known as Creatine Kinase (CK), is the enzyme that catalyzes the reaction of creatine and ATP to ADP. Elevated CPK indicate muscle necrosis, especially in Claustridial infections and longstanding severe cases of cellulitis
6. Interleukins (IL-6) levels correlate with severity of infection or inflammation
7. Ferritin is an iron storage protein, a leakage product of damaged cells, may also indicate levels of hydroxyl radical formation and oxidative stress
8. Tumor Necrosis Factor (TNF-α) and Complement factors also were used to stratify the severity of disease
9. Procalcitonin (PCT) is a protein marker, precursor to the hormone calcitonin, that can be used to monitor inflammation. It's levels in the blood remain low in healthy individuals, but in response to systemic bacterial infections and/or severe inflammation, the levels can rise significantly, making it a useful inflammatory marker

In our study, we routinely used only serial TWBC & Diff Count, ESR, CRP, ASO and Ferritin estimations, to signify the severity and to monitor improvement. Blood cultures are rarely helpful in the management, since the patients might already be on 'high' antibiotics, prescribed by referring physician[16,18,21]. Plain skiagram may reveal gas bubbles in gas gangrene, but not pathognomonic, since several non-Claustridial infections may also produce gas. USG or MRI of the leg may detect if an abscess has already formed, which may be confirmed by guided aspiration and get useful bacteriological information. Venous Doppler/Duplex study and D-dimer estimation may identify deep vein thrombosis. Most often, with no clinching investigation, cellulitis remains only a clinical diagnosis.

Natural Resources for Human Health
eISSN: 2583-1194

CONCEPT OF THE INNOVATIVE SURGICAL MANAGEMENT (MULTIPLE MINI-FASCIOTOMIES - MMF):

In cellulitis, infection spreads along the fascial planes, often deep-seated, with no opportunity to exit spontaneously and resolve, even under the influence of antibiotics[5]. If the infection is subfascial, a situation similar to compartment compression syndrome may develop. Our concept is to make multiple mini-fasciotomies by stab wounds through the skin, (using 10 or 15-sized surgical blade) all over the affected regions (usually leg and dorsum of foot), often as many as 30 of them, under cover of IV high antibiotics. This facilitates opening new tissue planes, by creating tiny holes in the fascia for the exit of infected fluid, with dramatic resolution of pain and swelling within 12-24 hours.

This is expected to break the vicious cycle of compartment compression phenomenon, infection -> inflammation -> lymph stasis -> edema, leading to favorable outcome. Swabs from the serous fluid exuding from those tiny wounds can be collected for microbiology (Gram stain and Culture), to guide selection of appropriate antibiotics.

Materials & Methods: The procedure is considered, only if there is no sign of improvement or there is worsening of the clinical picture, after a trial therapy with high antibiotics for about 3-5 days. The outcome of twenty patients treated by our surgical intervention were compared with 5 patients treated by conventional antibiotic therapy (as they were treated elsewhere and presented to us late), during the last 5 years. All patients received high antibiotics (our choice has been to administer IV Meropenem 500mg-1gm and Piperacillin 4.5gm with Tazobactam twice a day for 3-5 days and continue appropriate oral antibiotics, based on bacteriology, for 7-10 days)[13,14]. In diabetics, strict glycemic control is achieved by biphasic human insulin given 6th hourly, according to a standard sliding scale. All patients were followed for few weeks to one year after the treatment. Contrary to general precaution, we did not discontinue the antiplatelet agents perioperatively, if they were taking earlier, nor did we regret for not doing it, in terms of magnitude of bleeding.

Bacteriology in our study: Gram stain of the fluid exuding from the stab wounds and discharge from the ulcers (in cases treated elsewhere without intervention) revealed mostly Gm+ve cocci and bacilli (n-13) and Gm-ve bacilli (n-6).

Cultures revealed –

β-Hemolytic Streptococci – 7

Staphylococci - 6

Proteus – 4

Pseudomonas – 2

No growth reported in 6 samples

Surgery: The procedure, which takes only five minutes, is done under general anesthesia and we try to avoid injuring cutaneous nerves and superficial veins, as much as possible, by orienting their courses in those areas and never encountered any major problems in that regard. Peroperative bleeding is controlled by elevation and digital pressure over surgical pads. Postoperatively, limb elevation and elastic compression are employed for 12-18 hours, for hemostasis as well as for faster resolution of inflammatory edema. The tiny cuts in the skin made by a small blade don't require closure and heal without any evidence of intervention, within a few days. During the first inspection of the limb, at 12-24 hours after surgery, dramatic reduction of pain, swelling and warmth was noticed, signifying resolving pathology. In some cases, despite preop ultrasonogram reported no collection, frank pus poured out of the tiny incisions, which were enlarged by cruciate manner, for better drainage.

Various parameters were compared between both groups

Comparison of Clinical Outcomes Between MMF Group and No-Intervention Group		
Parameter	**MMF Group (n = 20)**	**No Intervention (n = 5)**
Duration of infection before intervention	3–5 days	3–5 days
Average duration of hospitalization	2 days	8 days

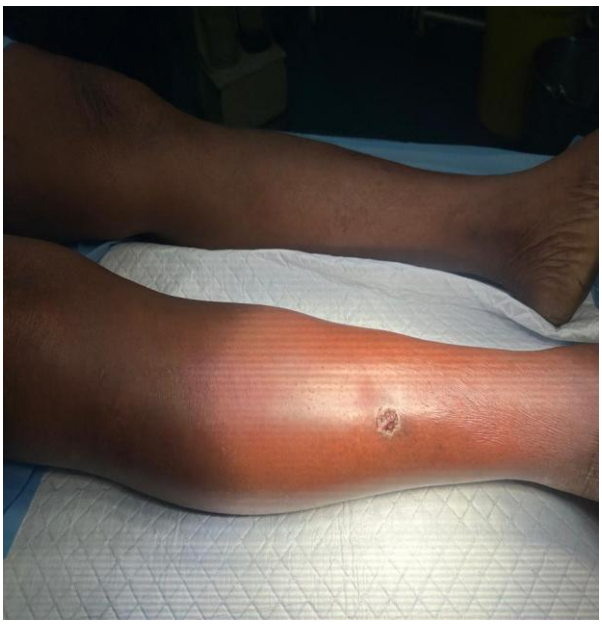
Duration of intravenous/high-dose antibiotic requirement	3 days	8–14 days
Minimal loss of overlying skin	None	2 cases
Extensive loss of overlying skin	None	2 cases
Time to near-total clinical resolution	15 days	4 weeks
Time for inflammatory markers to return to normal range	2–3 weeks	5 weeks

RESULTS & DISCUSSION:

From the pre and post-procedure photographs shown here, the faster resolution of the pathology, that never observed before (without intervention) may be appreciated. Though the exact mechanism of immediate control of infection is not clear, we can presume that this procedure decompresses the osteo-fascial compartments, breaking the vicious cycle. It also exposes the infected fluid to a wider surface area, giving an advantage to the defense forces to overcome the infection. The favorable results are so consistent; the satisfaction of the patients is immense and often surprising, when they see their leg at the time of first dressing after 12 hours. IV antibiotics may be switched to oral drugs after 72 hours, to continue as dictated by the clinical course.

Case-1 : Pictures 1a & 1b: Preop clinical condition (M/52/Smoker). Duration 3 days

1c, 1d, 1e & 1f *:* 18 hours postop, during the first inspection. Multiple tiny stab wounds all around the leg and dorsum of foot are visible



Pic : 1a

Pic : 1b

Natural Resources for Human Health
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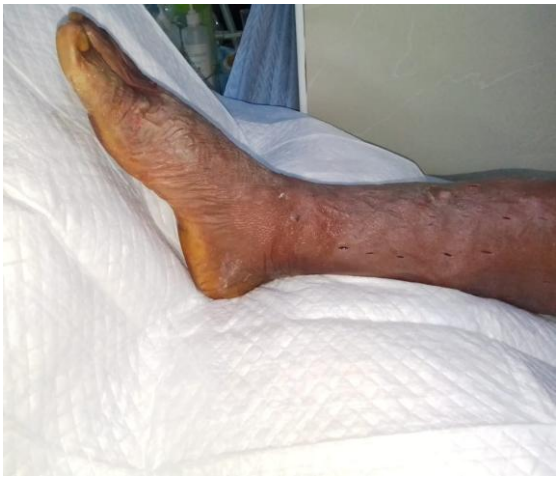
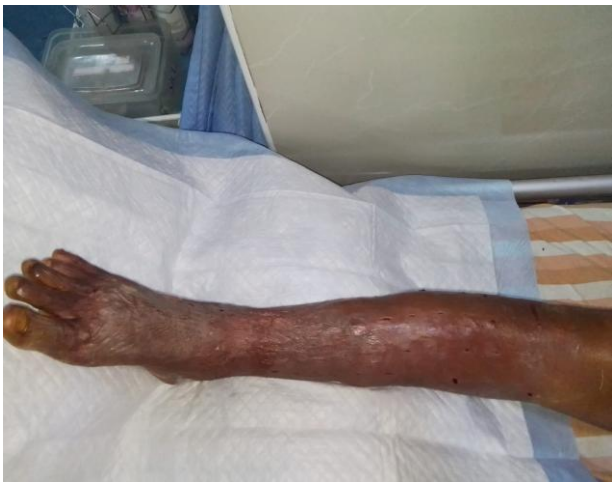
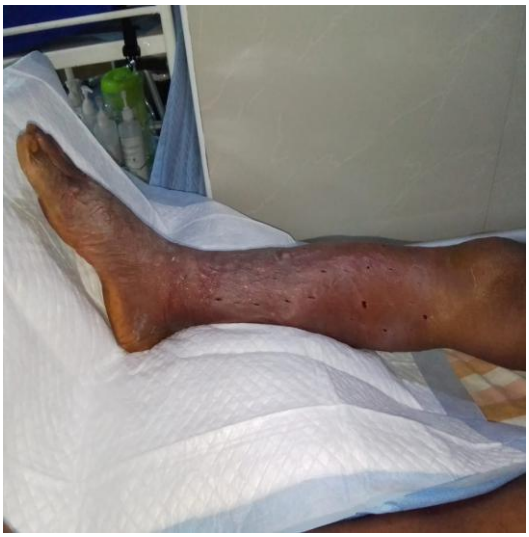


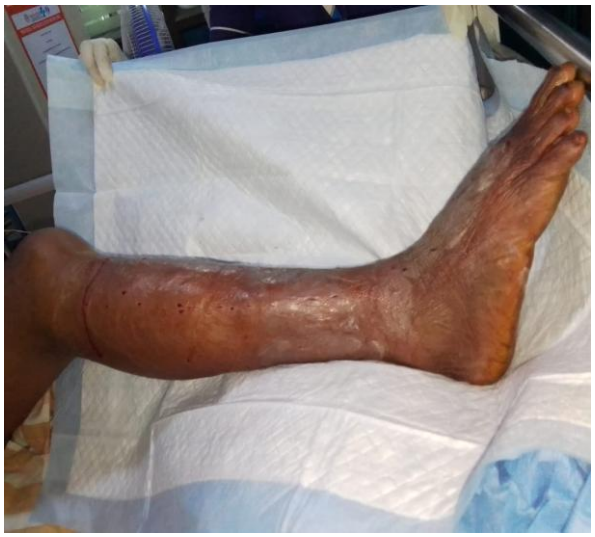
Pic : 1c



Pic : 1d



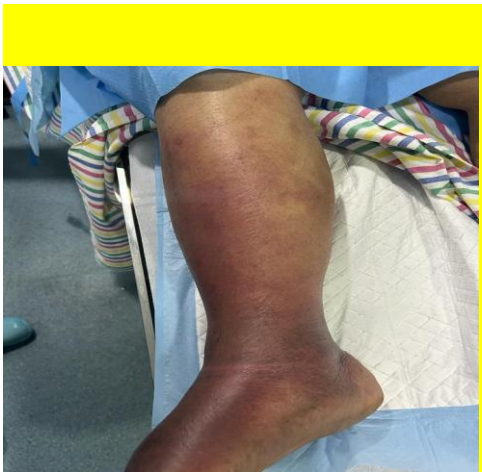
Pic: 1e



Pic: 1f

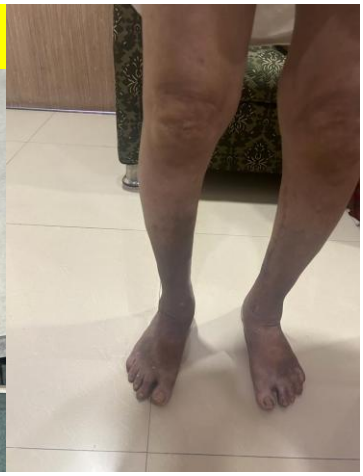
Case-2 : Pictures 2a & 2b: Preop clinical condition (M/55/Diabetic). Duration 5 days

2c : 9 days after the procedure. Stab wounds healed



Pic : 2a

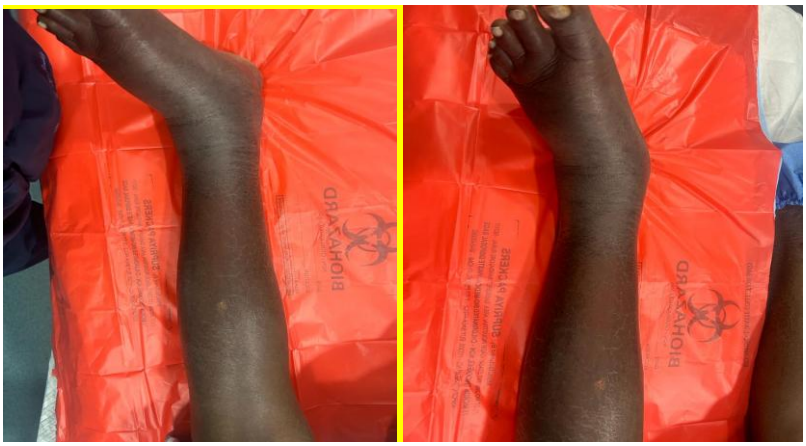
Pic : 2b



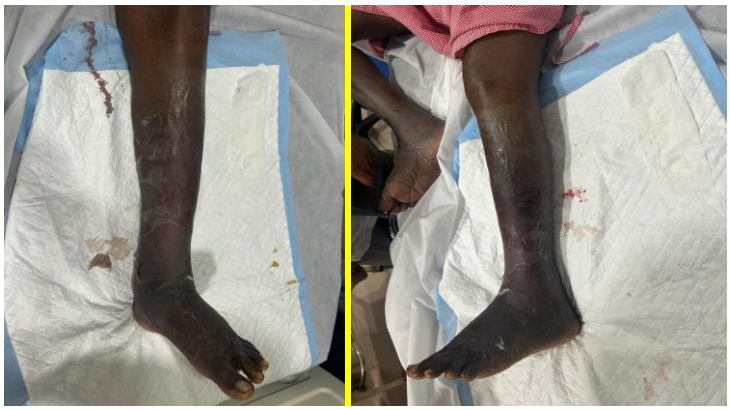
Pic : 2c

Case-3 : *Pictures* 3a & 3b: Preop clinical condition (M/65/Smoker). Duration 5 days

3c & 3d : 12 hours postop during first inspection. Tiny stab wounds are visible

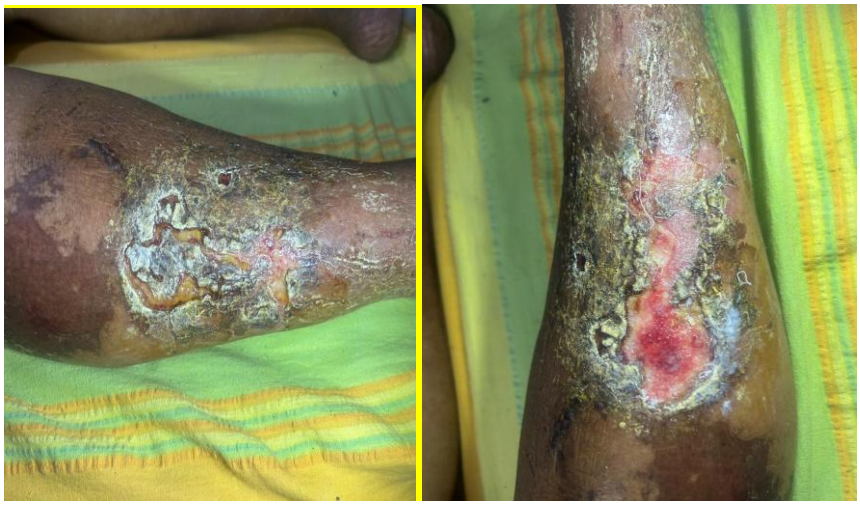


Pic : 3a Pic : 3b



Pic: 3c Pic: 3d

Case-4 : *Pictures* 4a & 4b : Preop clinical condition (F/54/Diabetic & Hypothyroid) Patient reported late, after the skin necrosis. Intervention not done. Duration two weeks.



Pic : 4a Pic : 4b

Natural Resources for Human Health
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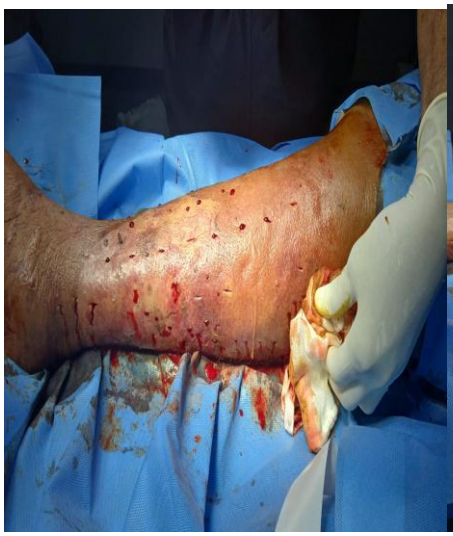
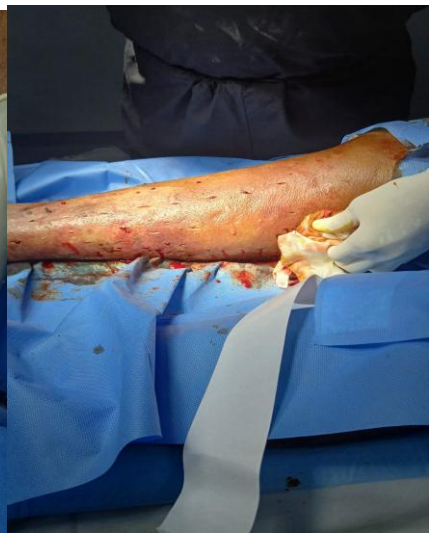
Case-5 : *Pictures 5a & 5b* : Preop clinical condition (M/60/Diabetic, obese) 4 days duration. Note pus pouring out of the stab wounds. Pic. 5c : During first dressings after 12 hrs

Pic : 5a



Pic : 5b



Pic: 5c

CONCLUSION: On reviewing the literature, this novel procedure has not been attempted nor documented by any surgeon till now, hence we are prompted to report this simple intervention, leading to dramatic improvement, which significantly reduces morbidity and minimizes hospitalization, in apparently hopeless situations. The number of cases may not be very high but the predictable results are statistically significant, worth trying by the other surgeons, when they encounter similar condition and record their experience.

DISCLAIMER: No conflict of interest to any of the authors or to any Pharma company

Fully *Informed Consent* was obtained from all the patients, witnessed by either the spouse or a close relative, after showing the pictures of the results in patients treated earlier with similar problem, with full knowledge of benefits and risks of the innovative procedure.

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