

Enhancement of Diabetic foot Ulcer treatment for using Electro spinning Dressing Material

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1 Introduction

In the modern era in human life faced the most complicated biological process that occurs in healing of wound. In the moment of after an injury, the biological pathways to immediately respond to the wound repair process in its become activated and are synchronized to respond healing process, however retain the ability to regenerate healing process throughout human life. Regenerate pathways in humans, which would change medical practice as much as the introduction of wound healing did in the twentieth century. Diabetes affects approximately 170 million people worldwide,

2.1 What is the wound

A wound by factual definition is a crash in the defensive function of the skin; the loss of continuity of epithelium[1-9], with or lacking loss of primary connective tissue (i.e. muscle, bone, nerves). A wound may be described in many ways; by its etiology, anatomical location, by whether it is acute or chronic, by the method of closure, by its presenting symptoms or undeniably by the exterior of the predominant tissue types in the wound bed. The wound also undergoes physical contraction throughout the entire wound healing process[10-16], which is believed to be mediated by contractile fibroblasts (myofibroblasts) that appear in the wound.

2.1.1 Wound Classification

Wounds may be classified by several methods; there an etiology, location, type of injury or presenting symptoms[17-21], wound depth and tissue loss or clinical appearance of the wound. General wounds are classified as being:

- Superficial (loss of epidermis only)
- Partial thickness (engage the epidermis and dermis)
- Full thickness (engage the dermis, subcutaneous fat and on instance bone)

The most widespread method for classification of a wound is identification of the leading tissue types in attendance at the wound bed that is black – necrotic and the relevant amount of each articulated as a proportion[22-29]. This categorization method is very visual, supports good assessment and planning and assists with uninterrupted reassessment.

2.1.2. wound healing

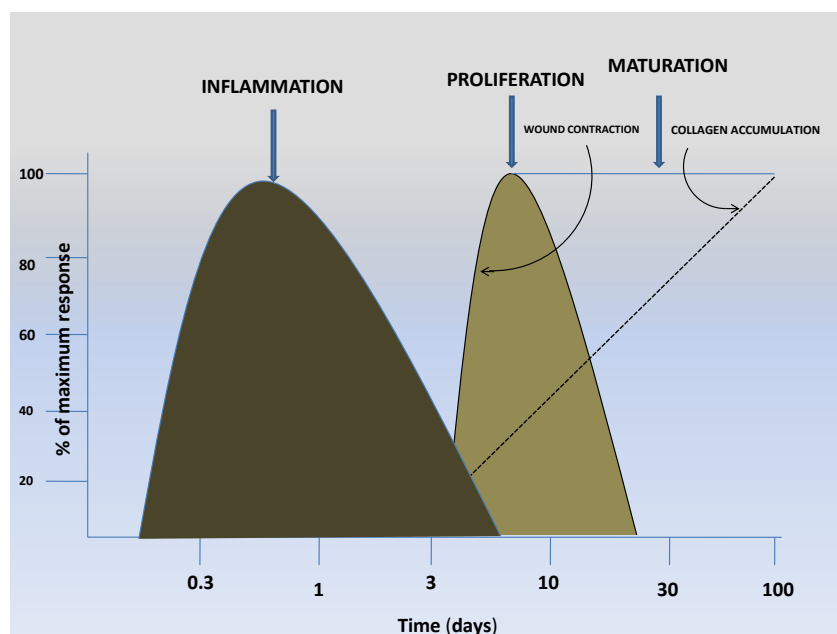
Wound healing is the course of action by which skin or other body tissue repairs itself subsequent to trauma. In undamaged skin, the epidermis (exterior layer) and dermis (deeper layer) form a protecting barrier aligned with the external environment[30-35]. When the barrier is busted, an orchestrated surge of biochemical events is set into motion to repair the damage. This process is alienated into conventional phases: blood clotting (hemostasis), inflammation, tissue enlargement (proliferation) and tissue modernize (maturation). Blood clotting may be well thought-out to be part of the inflammation stage as an alternative of a separate stage

2.1.3. Phases of Wound Healing

Whether wounds are closed by primary objective, theme to delayed primary closure or left to heal by secondary objective, the wound healing process is a vibrant one which can be divided into three phases. It is decisive to retain information that wound healing is not linear and repeatedly wounds can progress both forwards and back through the phases depending upon innate and extrinsic armed forces at work within the patient[36-45].

The phases of wound healing are:

- Inflammatory phase
- Proliferation phase
- Maturation phase



3. Diabetic wound healing

Diabetic foot is one of the most considerable and destructive complications of diabetes, and is defined as a foot precious by ulceration that is connected with neuropathy and/or peripheral arterial disease of the lower limb in a patient with diabetes

A diabetic foot ulcer is an wound that occurs in approximately 15 percent of patients with diabetes and is collectively positioned on the bottom of the foot. Of those who develop a foot ulcer, 6 percent will be hospitalized due to infection or other ulcer-related complication.

Diabetes is the foremost cause of non-traumatic lower extremity amputations in the world, and approximately 14-24 percent of patients with diabetes who develop a foot ulcer will require an confiscation. Foot ulceration precedes 85 percent of diabetes-related amputations. Research has shown, however, that development of a foot ulcer is escapable.

3.1 Taxonomy of Diabetic wound healing

The most extensively conventional taxonomy system for diabetic foot ulcers and lesions is the Wagner ulcer taxonomy system. This system [Table 1], which is based on the depth of penetration, the presence of osteomyelitis or gangrene, and the extent of tissue necrosis the drawback of the Wagner taxonomy system and The University of Texas taxonomy represent an progress in the healing of the diabetic foot. This system [Table 2] uses four grades, each of which is customized by the presence of infection (Stage B), ischemia (Stage C), or both (Stage D). This system has been validated and is in general extrapolative of outcome, since growing grade and stage of wounds are less likely to heal without revascularization or amputation. It is now widely used in several clinical trials and diabetic foot centers.

Since there are a manifold taxonomy schemes, it is unstated that each has its own set of advantages and drawbacks. The advantage of the Meggitt-Wagner and University of Texas taxonomy is that both systems have been shown to be predictive of poor outcomes

However, there are certain drawbacks of all current taxonomy:

- These taxonomy do not include all the diabetic foot complications.
- They are thorny to remember, principally University of Texas taxonomy and PEDIS taxonomy.
- They cannot be used as a teaching tool, as this taxonomy are difficult to be understood

Table 1 - WAGNER-MEGGITT CLASSIFICATION OF DIABETIC FOOT

Grade 0	No open lesions; may have deformity or cellulitis
Grade 1	Superficial diabetic ulcer (partial or full thickness)
Grade 2	Ulcer extension to ligament, tendon, joint capsule, or deep fascia without abscess or osteomyelitis
Grade 3	Deep ulcer with abscess, osteomyelitis, or joint sepsis
Grade 4	Gangrene localized to portion of forefoot or heel
Grade 5	Extensive gangrenous involvement of the entire foot

Table 2 - UNIVERSITY OF TEXAS CLASSIFICATION OF DIABETIC FOOT

	Grade 0		Grade 1		Grade 2		Grade 3
STAGE A	Preulcerative or postulcerative lesion completely epithelialized		Superficial wound, not involving tendon, capsule or bone		Wound penetrating to tendon capsule		Wound penetrating to bone or joint
STAGE B	Infection		Infection		Infection		Infection
STAGE C	Ischemia		Ischemia		Ischemia		Ischemia
STAGE D	Infection and Ischemia		Infection and Ischemia		Infection and Ischemia		Infection and Ischemia

3.2 Factors Affecting Wound Healing

Numerous factors can lead to impair wound healing. In general terms, the factors that persuade revamp can be categorized into confined and systemic. Confined factors are individuals that directly manipulate the characteristics of the wound itself, while systemic factors are the on the whole health or disease condition of the entity that affect his or her knack to heal (Table 3). Many of these factors are correlated, and the systemic factors act through the local effects affecting wound healing.

Local Factors	Systemic Factors
Oxygenation	Age and gender
Infection	Sex hormones
Foreign body	Stress

Venous sufficiency	Ischemia Diseases: diabetes, keloids, fibrosis, hereditary healing disorders, jaundice, uremia Obesity Medications: glucocorticoid steroids, non- steroidal anti-inflammatory drugs, chemotherapy Alcoholism and smoking Immuno compromised conditions: cancer, radiation therapy, AIDS Nutrition
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3.3 Local Factor That Influence Healing

3.3.1 Oxygenation

What role does oxygen play

Even as the exact way oxygen works in the wound healing process is not completely unstated, it's extensively renowned oxygen plays a role in virtually every part of the wound healing stages. When the body experiences a wound, it develop an increased need for bacterial resistance, cell propagation, collagen synthesis and angiogenesis, amongst other reparative function.

As reported in the British Journal of Dermatology, oxygen's foremost function lies in its aptitude to produce energy. In order for cells to appropriately reproduce and migrate, they must have a plenty amount of energy. Like all functions involved in the human biology, they have need of oxygen to be able to make energy. When an area of the body does not receive an passable amount of oxygen, a condition known as hypoxia, it can slow and even halt the healing progression.

How do I increase oxygen flow

Supplying wounds with this necessary is about much more than just inhalation, even though proper inhalation techniques are significant for wound healing as well as common health. ensure that the arteries and veins are pliant, open and clear is key to creation sure that blood flows to the wound bed and can transport with it oxygen molecules. That means subsequent your diabetes high blood pressure care plans to construct sure your cardiovascular system is in finest condition. moreover, quitting smoking and avoid excessive alcohol consumption can be advantageous to oxygen supply to the wound bed

4. Process of wound dressing materials

The process of dressing choice is determined by a number of factors together with the nature and position of the wound, and the assortment of materials available. In most situations the cost of healing is also a most important factor. This article describes some of these strictures in detail and provides advice on the arrangement of a structured approach to the selection process.

If we've eternally vocal with our doctor or constantly browsed through our local medical supply store, we capacity previously be attentive of the options patients have for wound dressings. With so much range reachable, include poles apart styles, core materials and indispensable usage; it can be thorny to choose the right dressing for your unique wound healing requirements. If you find manually stuck seeking out the best option, follow these handy tips for choosing the best dressing.

In recent years we encompass heard of a number of animal-related products and research studies that have insightful implication for the wound care manufacturing. Whether wound dressings made to simulate spider webs or using tilapia to improve wound healing rates, there are a number of hugely valuable animal species. If there's one creature you would not take for granted to be helpful, the crocodile might come to mind. Over the last several months, there has been a number of impressive wound care breakthrough courtesy of animal crop. That includes a powerful foam inspired by frogs and wound dressings made from eggshells. Moreover, scientists have used Zebra fish to study the properties of skin growth. Now, fish are once again pushing the precincts of wound healing expertise.

The wound care production is all about exploring new ideas to lessen costs and recover patient treatment. While options like honey, foam and collagen are more established, there are wound dressings made from a slew of unlikely sources. That list includes crab shells, algae and special fluorescent dye, among several other exceptional types. Now, there could be a new dressing array made from a source with a little more history in the wound care industry.

There are numerous wound dressing types, like hydrocolloid and collagen that remove slough and foster tissue regrowth. Many existing ointments, like alginate, are perfect for chronic leg ulcers. Hypochlorous acid, in the interim, is perfect for tackling the biofilms that develop on chronic wounds. And research into more efficient treatments happens all the time, as with the development of solutions like the Coban 2 Compression System and Hydrofera Blue Ready.

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5. Different types of natural drug in wound healing (Reaction and mechanism)

The variety of wound types has resulted in a wide range of wound dressings with new products frequently introduced to target different aspects of the wound healing process. The ideal dressing should achieve rapid healing at reasonable cost with minimal inconvenience to the patient. This article offers a review of the common wound management dressings and emerging technologies.

for achieving improved wound healing. It also reviews many of the dressings and novel polymers used for the delivery of drugs to acute, chronic and other types of wound. These include hydrocolloids, alginates, hydrogels, polyurethane, collagen, chitosan, pectin and hyaluronic acid. There is also a brief section on the use of biological polymers as tissue engineered scaffolds and skin grafts. Pharmacological agents such as antibiotics, vitamins, minerals, growth factors and other wound healing accelerators that take active part in the healing process are discussed. Direct delivery of these agents to the wound site is desirable, particularly when systemic delivery could cause organ damage due to toxicological concerns associated with the preferred agents. This review concerns the requirement for formulations with improved properties for effective and accurate delivery of the required therapeutic agents. General formulation approaches towards achieving optimum physical properties and controlled delivery characteristics for an active wound healing dosage form are also considered briefly

6. Conclusion

In conclusion, we can state that, for this application, we could use modern wound dressing, namely Hydrocolloid dressing, which is the most widely used in the medical market, due to its properties such as vapour permeability with absorbency and comfortability for the patient, avoiding pain on removal. In addition, regarding the cancer therapy, it is important to develop controlled release drugs, providing a prolonged action of the drug activity for a long period of time. Hydrocolloid dressing based on PLGA could be an emerging alternative, once combined with chitosan and zeolite. Studies in both composites CS and zeolite have reported that the first one has antimicrobial activity, good coagulation and immunostimulating ability. Gadolinium loaded with CS appears to be promising in subcutaneous B16F10, melanoma cancer. The second one has very strong

anti-oxidative properties that could affect an oxidative stress cancer. On the other hand, we point out that TiO₂ should be avoided after UV irradiation, as the particles of smaller size have a higher penetration capacity and may pass through the skin, penetrating into the tissues and may be a risk to human health. When used for prolonged period, it can cause dermal toxicity, free radicals generation and oxidative stress that can lead to skin aging.

7. References

1. Khanaa, V., Thooyamani, K.P., Udayakumar, R., Multi resign encryption protocol scheme for an identification of malicious mobile agent host, World Applied Sciences Journal, V-29, I-14, PP-299-303, 2014
2. Khanaa, V., Thooyamani, K.P., Udayakumar, R., A novel approach towards prevention of spam, phishing, controlling hierarchical access using Domain Keys, World Applied Sciences Journal, V-29, I-14, PP-181-185, 2014
3. Khanaa, V., Thooyamani, K.P., Udayakumar, R., Dual tree complex wavelet transform for adaptive interferogram residual reduction, Middle - East Journal of Scientific Research, V-20, I-9, PP-1059-1064, 2014

4. Khanaa, V., Thooyamani, K.P., Udayakumar, R., An improved rao-blackwellized particle filter for GPS-INS integrated navigation, Middle - East Journal of Scientific Research, V-20, I-9, PP-1111-1115, 2014
5. Khanaa, V., Thooyamani, K.P., Udayakumar, R., WSN based gas leakage detecting and locating system for petrochemical industry, Middle - East Journal of Scientific Research, V-20, I-9, PP-1107-1110, 2014
6. Khanaa, V., Thooyamani, K.P., Udayakumar, R., Information sharing time based controlled system in emergency situations, Middle - East Journal of Scientific Research, V-18, I-12, PP-1845-1850, 2013
7. Kumar, J.R., Vikram, C.J., Naveenchandran, P., Investigation for the performance and emission test using citronella oil in single cylinder diesel engine, Middle - East Journal of Scientific Research, V-12, I-12, PP-1754-1757, 2012
8. Manavalan, S., Golden Renjith Nimal, R.J., Efficient and evaluation properties of medicinal products and flowering plant conventional diesel, International Journal of Pure and Applied Mathematics, V-116, I-19 Special Issue, PP-407-411, 2017
9. Manavalan, S., Jose Ananth Vino, V., Extraction and optimization of Biodiesel from neem oil, International Journal of Pure and Applied Mathematics, V-116, I-19 Special Issue, PP-401-404, 2017
10. Manavalan, S., Rakesh, N.L., Heat transfer enhancement in shell and tube heat exchangers using twisted tapes, International Journal of Pure and Applied Mathematics, V-116, I-17 Special Issue, PP-405-407, 2017
11. Manikandan, J., Hameed Hussain, J., Design on blind shoe using ATMEGA328 arduino, International Journal of Pure and Applied Mathematics, V-116, I-19 Special Issue, PP-413-415, 2017
12. Manikandan, J., Hameed Hussain, J., Design and fabrication of vibrating table for seperating of nuts using different sizes mesh, International Journal of Pure and Applied Mathematics, V-116, I-19 Special Issue, PP-417-419, 2017
13. Manikandan, J., Hussain, J.H., Design on blind shoe using ATMEGA328 micro controller, International Journal of Mechanical Engineering and Technology, V-8, I-8, PP-1575-1579, 2017
14. Manikandan, J., Hussain, J.H., Design and fabrication of blind shoe using ATMEGA328 micro controller and vibration motor, International Journal of Pure and Applied Mathematics, V-116, I-17 Special Issue, PP-287-289, 2017
15. Manikandan, J., Hussain, J.H., Design and fabrication of blind shoe using ATMEGA328 micro controller and vibration motor, International Journal of Mechanical Engineering and Technology, V-8, I-8, PP-1588-1593, 2017
16. Manikandan, J., Sabarish, R., Waste heat recovery power generation system using thermoelectric generators, International Journal of Pure and Applied Mathematics, V-116, I-17 Special Issue, PP-85-88, 2017
17. Meenakshi, D., Udayakumar, R., Protocol with hybridized bluetooth scatternet formation for wireless network, International Journal of Applied Engineering Research, V-9, I-22, PP-7299-7307, 2014

18. Meikandaan, T.P., Hemapriya, M., Use of glass FRP sheets as external flexural reinforcement in RCC Beam, International Journal of Civil Engineering and Technology, V-8, I-8, PP-1485-1501, 2017
19. Meikandaan, T.P., Hemapriya, M., Use of glass FRP sheets as external flexural reinforcement in RCC beam, International Journal of Pure and Applied Mathematics, V-116, I-13 Special Issue, PP-481-485, 2017
20. Meikandaan, T.P., Hemapriya, M., Study on properties of concrete with partial replacement of cement by rice husk ash, International Journal of Pure and Applied Mathematics, V-116, I-13 Special Issue, PP-503-507, 2017
21. Meikandaan, T.P., Hemapriya, M., Experimental behaviour of retrofitting of prestressed concrete beam with FRP laminates, International Journal of Pure and Applied Mathematics, V-116, I-13 Special Issue, PP-509-513, 2017
22. Meikandaan, T.P., Hemapriya, M., Study of damaged RC beams repaired by bonding of CFRP laminates, International Journal of Pure and Applied Mathematics, V-116, I-13 Special Issue, PP-495-501, 2017
23. Meikandaan, T.P., Hemapriya, M., Experimental study on strengthening of shear deficient RC beam with externally bonded GFRP sheets, International Journal of Pure and Applied Mathematics, V-116, I-13 Special Issue, PP-487-493, 2017
24. Michael, G., Arunachalam, A.R., Srigowthem, S., Ecommerce transaction security challenges and prevention methods-new approach, International Journal of Pure and Applied Mathematics, V-116, I-13 Special Issue, PP-285-289, 2017
25. Michael, G., Karthikeyan, R., Studies on malicious software, International Journal of Pure and Applied Mathematics, V-116, I-8 Special Issue, PP-315-319, 2017
26. Michael, G., Srigowthem, S., Vehicular cloud computing security issues and solutions, International Journal of Pure and Applied Mathematics, V-116, I-8 Special Issue, PP-17-21, 2017
27. Micheal, G., Arunachalam, A.R., EAACK: Enhanced adaptive acknowledgment for MANET, Middle - East Journal of Scientific Research, V-19, I-9, PP-1205-1208, 2014
28. Murugesh, Kaliyamurthie, Thooyamani, K.P., ICI self-cancellation scheme for OFDM systems, Middle - East Journal of Scientific Research, V-18, I-12, PP-1775-1779, 2013
29. Murugesh, Kaliyamurthie, Thooyamani, K.P., Preprocessing and postprocessing decision tree, Middle - East Journal of Scientific Research, V-13, I-12, PP-1599-1603, 2013
30. Nakkeeran, S., Hussain, J.H., Innovative technique for running a petrol engine with diesel as a fuel, International Journal of Pure and Applied Mathematics, V-116, I-18 Special Issue, PP-41-44, 2017
31. Nakkeeran, S., Nimal, R.J.G.R., Anticipation possessions for seismic use carbon black on rubbers, International Journal of Pure and Applied Mathematics, V-116, I-17 Special Issue, PP-63-67, 2017
32. Nakkeeran, S., Sabarish, R., New method of running a petrol engine with diesel as fuel, International Journal of Pure and Applied Mathematics, V-116, I-18 Special Issue, PP-35-38, 2017

33. Nakkeeran, S., Vino, J.A.V., Prevention effects for earthquakes using carbon black on rubbers, International Journal of Pure and Applied Mathematics, V-116, I-17 Special Issue, PP-301-305, 2017
34. Nakkeeran, S., Vino, J.A.V., Performance development by using mesh plates in parallel and counter flows of heat exchangers, International Journal of Pure and Applied Mathematics, V-116, I-17 Special Issue, PP-291-295, 2017
35. Nalini, C., Arunachalam, A.R., A study on privacy preserving techniques in big data analytics, International Journal of Pure and Applied Mathematics, V-116, I-10 Special Issue, PP-281-285, 2017
36. Nalini, C., Ayyappan, G., Academic social network dataset applying various metrics for measuring author's contribution, International Journal of Pure and Applied Mathematics, V-116, I-8 Special Issue, PP-341-345, 2017
37. Nalini, C., Brintha Rajakumari, S., Iron toxicity of polluted river water based on data mining prediction analysis, International Journal of Pure and Applied Mathematics, V-116, I-8 Special Issue, PP-353-356, 2017
38. Nandhini, P., Arunachalam, A.R., Fault-tolerant quality using distributed cluster based in mobile ADHOC networks, International Journal of Pure and Applied Mathematics, V-116, I-8 Special Issue, PP-365-368, 2017
39. Nandhini, P., Arunachalam, A.R., Security for computer organize database assaults from threats and hackers, International Journal of Pure and Applied Mathematics, V-116, I-8 Special Issue, PP-359-363, 2017
40. Nandhini, P., Arunachalam, A.R., Mobile ADHOC networks: Security and quality of services, International Journal of Pure and Applied Mathematics, V-116, I-8 Special Issue, PP-371-374, 2017
41. Naveenchandran, P., Vijayaragavan, S.P., A high performance inverter fed energy efficient cum compact microcontroller based power conditioned distributed photo voltaic system, International Journal of Pure and Applied Mathematics, V-116, I-13 Special Issue, PP-165-169, 2017
42. Naveenchandran, P., Vijayaragavan, S.P., Combination of wind energy-solar energy power generation, International Journal of Pure and Applied Mathematics, V-116, I-13 Special Issue, PP-117-121, 2017
43. Naveenchandran, P., Vijayaragavan, S.P., A sensor less control of SPM using fuzzy and ANFIS technique, International Journal of Pure and Applied Mathematics, V-116, I-13 Special Issue, PP-43-50, 2017
44. Nima, R.J.G.R., Hussain, J.H., Design and fabrication of an indexing fixture in a shaper machine, International Journal of Pure and Applied Mathematics, V-116, I-18 Special Issue, PP-441-445, 2017
45. Nimal, R.J.G.R., Hussain, J.H., Deflection and stress analysis of spur gear tooth using steel, International Journal of Pure and Applied Mathematics, V-116, I-17 Special Issue, PP-119-124, 2017

