

# Methacrylate Powder Dressing in Traumatic, Burn, Venous Ulcers and Pressure Sores Wounds Healing

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**Abstract:**

**Background:** The goal of methacrylate powder dressing is to treat burn, pressure sores, and traumatic raw areas to give patients a healed wound and to let them resume their life, ambulate, and go back to work while preventing risks of surgery. Methacrylate is a sterile white powder composed of organic polymers. Once poured into a wound, the particles absorb exudate from the wound site, then hydrate and aggregate to form an irreversible film dressing. The aggregated powder provides a perfect moist wound environment advocating cellular function and tissue repair and do not permit exogenous bacteria to penetrate the dressing. **Objectives:** The aim of this study is to evaluate the effect methacrylate powder in healing of chronic non-healing pressure sores, burns "partial thickness burns 2nd degree burn", venous ulcers and acute traumatic wounds in terms of shortening duration of healing, ease of use, serous exudates, and less pain. **Patients and methods:** From 2020 to 2021 30 patients with a clinical diagnosis of 2nd, 3rd degree burn, venous ulcers, pressure sores and post traumatic were enrolled in this study.

Face and perineal wounds, necrotic wounds with unhealthy granulation tissues till debridement and healthy granulation tissue, wounds with exposed tendons muscle and bone and diabetic wounds were excluded. Patients underwent dressing with methyl acrylate powder every 7-10 days according to soaking of the dressing. **Results:** 20 (66.6%) cases completely healed with normal epithelium, 7 (23.3%) cases did not respond and needed graft and 3 (10%) cases complicated with reopening and need graft. In 17 cases the cause of injury was burn, in 7 (23.3%) cases the cause of injury was pressure sores, in 3 (10%) cases the cause of injury was trauma and 3 (10%) cases had venous ulcers. Number of dressings ranged from 2 to 5 resulting in an average of 3. Duration of healing ranged from 2weeks to 5 weeks, resulting in average of 3

weeks. **Conclusion:** Methacrylate powder dressing offers a helpful solution in healing of different types of burn, pressure sores, post traumatic patient with raw areas with minimal pain due to less numbers of dressings, but multiple dressings increasing cost. It should be considered in wounds with expected long duration of healing with traditional methods and in patients who refused surgery to cover their raw area. Proper selection of patients is a must as it is a costly method of dressing.

**Key words:** Methacrylate, healing, dressings, burn, pressure sores.

## **Introduction**

The largest and first protective organ in the body is the skin, covering the whole external surface and representing the first physical barrier against the environment. Temperature regulation and protection from ultraviolet (UV) light, trauma, and protection from infections, germs, and toxins are all functions of skin. Immunologic monitoring, sensation, fluid loss management, and homeostasis are also functions of the skin. (1)

The plexuses present between the reticular and papillary layers of the dermis provide a significant amount of vascularization to the skin. A vast network of blood arteries and capillaries extends from regional branches of the systemic circulation to local sites throughout subcutaneous tissue and dermis, supplying blood.(2). According to thickness, wounds classified in superficial (partial thickness, full thickness), deep and

complicated, according to wound complexity to simple, combined, according to level of contamination to clean wound, contaminated wound, and infected colonized wound.(3)

Platelets, keratinocytes, immune cells, microvascular cells, and fibroblasts all play apart in the reestablishment of tissue integrity during acute wound healing. The wound healing process is classified into 4 temporarily phases: coagulation, inflammation, granulation tissue formation (proliferative phase), and remodeling or scar formation phase. (4)

Different types of wounds can be treated with dressing either with gauzes, foams, honey, and silver dressings or may need sutures in deep cut wounds or skin graft as in deep 2nd degree burn and third degree

burn or flaps in some third or fourth degree burns or post traumatic wounds.(5)

Although managing wounds is often considered challenging, it is not needed to be a difficult task if basic care principles are followed. While the doctors have access to a plethora of topical treatment, antimicrobial, and dressings, few of these have prospective data to support their efficacy in wound healing. However, cotton gauze dressings have been considered the standard of care (even in clinical trials), others primary and secondary dressings are already available. (6)

As needed, highly-absorbency and moisture-retaining foam dressing, acrylics, alginates, hydrofibers, hydrocolloids, honey alginates, oxidized regenerated cellulose, micronized collagen, and others materials are investigated. Many solutions with silver to control bacterial contamination are also available, but they have the disadvantages of requiring daily dressing and being more expensive. (3)

Negative pressure therapy, which was first used in the mid-1990s, has played a significant role in the treatment of traumatic, acute, and chronic wounds. Negative pressure therapy is useful for maintaining

skin grafts, flaps, and surgical incisions but it does not guarantee complete healing. (3)

Hyperbaric oxygen therapy has been supported as being beneficial for a many of chronic wounds for decades but only available in special centers that not available everywhere and somewhat more expensive. (7)

Methacrylate is a sterile white powder composed of organic polymers. The particles are nanoscopic in size. Once poured into a wound, the particles absorb exudate from the wound site, then hydrate and aggregate to form an irreversible film dressing. Aggregate is a strong & resistant covering sheet which is in complete contact to the wound. The aggregated powder becomes a flexible moisture permeable film over the surface of the wound that provides a perfect moist wound environment helping cellular function and tissue repair while preventing exogenous microorganisms from entering the dressing. (8)

In this study, the methacrylate powder dressing was used in 2nd, 3rd degree burn (flame, scald, chemical, frictional), pressure sores, venous ulcers and post traumatic patients.

## **Methodology**

This is a case series, designed by a prospective study. For this study, 30 patients with wounds in different parts of the body were selected to demonstrate its dressing with methacrylate powder. These all patients had clean wounds with healthy granulation tissue whether the cause was post-traumatic wounds, burn (Partial thickness burns / 2nd Degree burn wound), pressure sores or venous ulcers. Patients with face and perineal wounds, diabetic wounds, necrotic wounds with unhealthy granulation tissues till debridement and healthy granulation tissue or wounds with exposed tendons, muscle and bone were excluded.

The patients with clean wounds fulfilling the above criteria had there follow up in outpatient clinics and some with more complicated issues were admitted to the plastic surgery unit in Benha University hospital and plastic surgery department in Ras El -Ten general hospital Alexandria University in the period from 2020 to 2021. Patients' ages ranged from 1.5 to 65 years, resulting in an average of 29.

For diabetic patient regular blood glucose measurement to control blood sugar and modify eating habits. Doppler u/s, leg

elevation and compression bandage for patients with venous ulcers.

After an approval from the Research Ethics Committee in Benha Faculty of Medicine and fully informed written consents from all patients regarding photographing, the new procedure of dressing, the non-expected healing time or number of dressings and follow up. Each patient underwent complete history taking about the mechanism of injury, duration, previous dressing methods, amount of discharge, its color and its odor and any previous surgeries

### **The Procedure**

We started with preparing and cleaning the wound bed, then applied methacrylate powder to the entire wound bed to form a thin, uniform layer. Accelerate powder transformation could be done with sterile saline or similar solution. Methacrylate powder did not necessarily require a second layer of the powder. Application of a secondary dressing was done if deemed clinically necessary.

Methacrylate powder approved that it could keep it in place for up to 7 days. But if the wound produces exudate the dressing becomes soaked so the wound was inspected for infection, inflammation, excessive

bleeding or fluid, odor, or irritation. The color of dressing was an indicator when the next one was white, off-white, yellow (keep it), if dark yellow (keep monitoring), if brown (change it). To change dressing, it was saturated with saline and gently lifted away with forceps.

Assessment every 5-7 days. If there was a good response after 7 days, then we applied another set of powder after 7 days. If deep wound, we looked for granulation tissue & when cavity was healed with granulation tissue we assessed the superficial wound, if it will heal by creeping of skin or need split thickness skin graft.

## Results

Among these 30 patients, there were 18 men (60%) and 12 women (40%). The ages ranged from 1.5 to 65 years, resulting in an average of 29. In 17 cases, the cause of the injuries was burn (57%), (8 cases with scald burn (26.7%), 4 cases with chemical burn (13.3%), 4 patients had flame burn wound (13.3%), and 1 patient had a frictional burn wound (3.3%)). 7 cases with pressure sore wounds (23.3%), 3 cases due to trauma reaching the fascia (27%), 4 patients had full thickness wound reaching the fascia (13%). Epithelization occurred in 20 patients (66,7

(10%), 3 cases due to venous ulcers (10%). As comorbidities, there were 7 cases diabetics (23.3%), 5 had hypertension (16.6%), 3 cases with previous history of deep venous thrombosis (10%), 2 cases of ischemic heart disease (6.6%), 1 patient was paraplegic (3.3%). and no comorbidities in 12 cases (40%). 11 cases are smokers (36.6%) and 1 case ex-smoker (3.3%).

The site of the wound was on the back in 5 patients (16.7%), on the chest in 3 patients (10%), on the flank in 1 patient (3,3%), on the foot in 10 patients (33,3%), on the forearm in 1 patient (3,3%), on the gluteal region in 4 patients (13,3%), on the hand in 1 patient (3,3%), on the knee in 1 patient (3,3%), on the leg in 1 patient (3,3%), on the medial malleolus in 1 patient (3,3%), on the sacrum in 1 patient (3,3%) and on the shoulder in 1 patient (3,3%)

Number of dressings ranged from 2 to 5, resulting in an average of 3. Duration of healing ranged from 2 weeks to 5 weeks, resulting in average of 3 weeks. 12 patients had deep 2nd degree burn (40%), 6 patients had superficial 2nd degree burn (20%), 8 patients had full thickness skin loss not % but 3 cases reopened (10%), 7 patients showed no epithelization and need graft (23, 3%).

**As regard the site of the wound:**

16.7% is at back, 13.3% is at gluteal region, 10% is at chest, 3.3% is at hand, 3.3% is at flank, 3.3% is at knee, 33.3% is at foot, 3.3% is at leg, 3.3% is at Forearm, 3.3% is at medial malleolus, 3.3% is at sacrum, 3.3% is at shoulder.

**As regard the cause:**

26.7% due to scald burn, 10% due to trauma, 13.3% due to chemical burn, 13.3% due to flame burn, 23.3% due to pressure sore, 10% due to venous ulcers, 3.3% due to frictional burn.

**As regard depth of wound:**

20% were superficial 2nd degree, 40% were deep 2nd degree, 26.7% were full thickness not reaching fascia, 13.3% were full thickness reaching fascia.

**As regard number of dressing:**

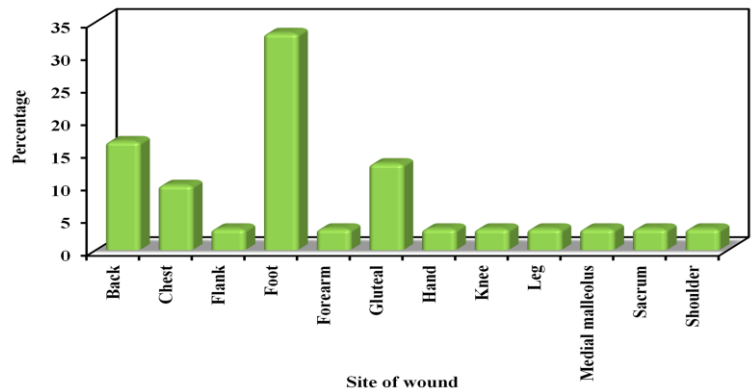
It ranged from 2 to 5, resulting in an average of 3.

**As regard epithelization:**

Epithelization occurred in 20 patients (66,7 %), 3 cases reopened (10%), 7 patients showed no epithelization and need graft (23, 3%).

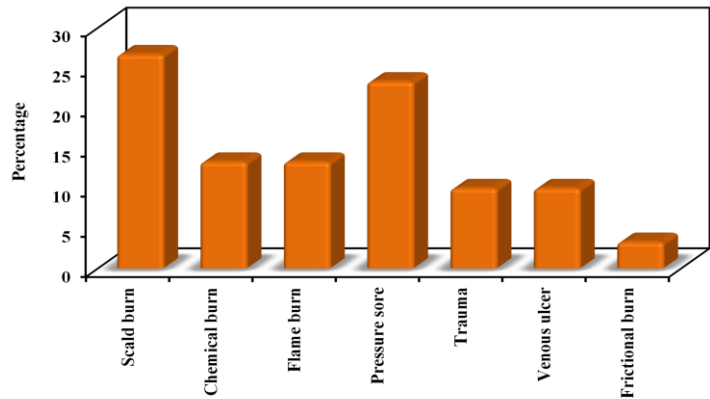
**Table (1):** Distribution of the studied cases according to site of wound (n = 30)

Site of wound	No.	%
Back	5	16.7
Chest	3	10.0
Flank	1	3.3
Foot	10	33.3
Forearm	1	3.3
Gluteal	4	13.3
Hand	1	3.3
Knee	1	3.3
Leg	1	3.3
Medial malleolus	1	3.3
Sacrum	1	3.3
Shoulder	1	3.3



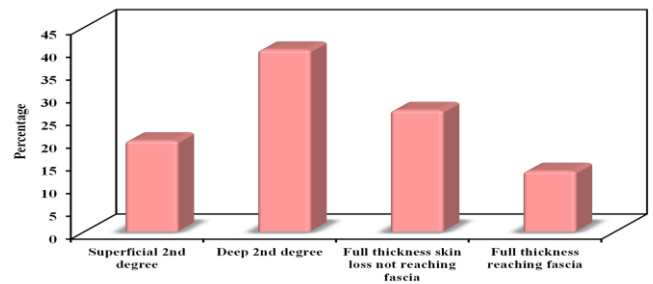
**Table (2):** Distribution of the studied cases according to cause (n = 30)

Cause	No.	%
Scald burn	8	26.7
Chemical burn	4	13.3
Flame burn	4	13.3
Pressure sore	7	23.3
Trauma	3	10.0
Venous ulcer	3	10.0
Frictional burn	1	3.3



**Table (3):** Distribution of the studied cases according to depth of wound (n = 30)

Depth of wound	No.	%
Superficial 2nd degree	6	20.0
Deep 2nd degree	12	40.0
Full thickness skin loss not reaching fascia	8	26.7
Full thickness reaching fascia	4	13.3

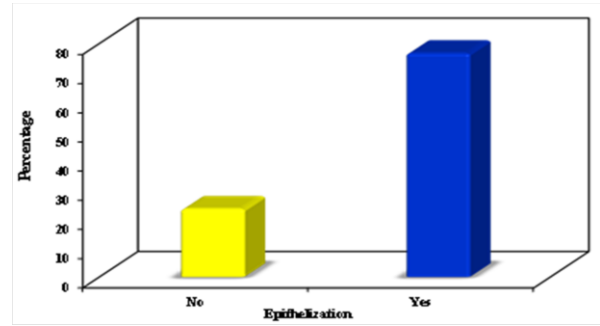


**Table (4):** Distribution of the studied cases according to number of dressing (n = 30)

Times of dressing	No.	%
2	9	30.0
3	13	43.3
4	6	20.0
5	2	6.7
<b>Min. – Max.</b>	<b>2.0 – 5.0</b>	
<b>Mean ± SD.</b>	<b>3.03 ± 0.89</b>	
<b>Median (IQR)</b>	<b>3.0 (2.0 – 4.0)</b>	

**Table (5):** Distribution of the studied cases according to epithelization

Epithelization	No.	%
Complete epithelization	20	66.7%
No epithelization & need graft	7	23.3%
Reopened & need graft	3	10%



## Discussion

This study included 30 patients, there were 18 men (60%) and 12 women (40%). The ages ranged from 1.5 to 65 years. In 17 cases, the cause of the injuries was burn (57%), 7 cases with pressure sore wounds (23.3%), 3 cases due to trauma (10%), 3 cases due to venous ulcers (10%). As comorbidities, there were 7 cases diabetics (23.3%), 5 had hypertension (16.6%), 3 cases with previous history of deep venous thrombosis (10%), 2 cases of ischemic heart disease (6.6%), 1 patient was paraplegic (3.3%). and no comorbidities in 12 cases (40%). 11 cases are smokers (36.6%) and 1 case ex-smoker (3.3%).

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medial malleolus in 1 patient (3.3%), on the sacrum in 1 patient (3.3%) and on the shoulder in 1 patient (3.3%)

Number of dressings ranged from 2 to 5 times, resulting in an average of 3. Duration of healing ranged from 2 weeks to 5 weeks, resulting in average of 3 weeks. 12 patients had deep 2nd degree burn (40%), 6 patients had superficial 2nd degree burn (20%), 8 patients had full thickness skin loss not reaching the fascia (27%), 4 patients had full thickness wound reaching the fascia (13%). Epithelization occurred in 20 patients (66,7 %) but 3 cases reopened (10%), 7 patients showed no epithelization and need graft (23, 3%).

In April 2009, Dr. Ryan H Fitzgerald was the first who used methacrylate powder in the management of a necrotizing fasciitis after several debridement in American woman, 43 years old with diabetes mellitus. After debridement, the patient had a large



dorsal foot wound and multiple wound healing techniques were used. Negative pressure wound therapy (NPWT) was used early after surgery to manage drainage and to help granulation tissue formation then the patient was converted to a methacrylate powder dressing on day 4. Patient mentioned a decrease in pain when dressing transitioned from NPWT to the use of methacrylate powder dressing. After 2 weeks after debridement, granulation tissue development and neo-epithelialization can be seen under the nanoparticulate dressing. To ensure definitive soft tissue closure, a 0.016-inch split-thickness skin graft was placed to the rest of dorsum of foot. (9)

Treating lower leg surgery wounds was explained in two older patients with methacrylate powder dressing. After two weeks of powder use, complete granulation developed, followed by complete healing in less than four weeks, all while requiring no patient or nursing wound care.(10)

In this study, methacrylate powder was used in 3 traumatic patients. First patient was 13years old male with post traumatic wound on knee (full thickness). After 3 weeks of dressing, the raw area decreased in size but he needed graft to cover the rest. Second patient was 22years old male with

post traumatic wound on the dorsum of the foot. After 3 weeks of dressing complete healing with epithelization occurred. Third patient was 55 years old male with HTN and post traumatic wound on back. After 4 weeks of dressing split thickness graft needed to cover the raw area.

In a research done 2018, methacrylate powder was used with two skin ulcers on legs of 47-year-old man. On the medial malleolus, the first ulcer measured 5×4 cm long and 1 cm deep. The second wound was L-shaped that ran from medial side of tibia to the anterior surface, measuring 12×10 cm and 1 cm in depth. Its boundaries were uneven, erythematous and macerated borders. In the first 2 weeks, the dressing was changed three times a week, then once a week. He saw an almost complete re-epithelization of both the bed and the wound edges after 20 weeks. (11)

In this study, methacrylate powder was used in three patients with venous ulcers; First patient was 50years old diabetic female with venous ulcer on medial malleolus. We used 2 sachets of methacrylate powder for weekly dressing. After 2 weeks complete healing with epithelization occurred. Second patient was 40 years old diabetic male with venous ulcer on foot (partial thickness). He

consumed 2 sachets of methacrylate powder. After 2 weeks epithelization was noticed. Third patient was 44 years old female with DVT (partial thickness). After 4 weeks of regular dressing with methacrylate powder the raw area decreased but no complete healing occurred and needed graft.

Methacrylate powder was used in two patients, the first patient was a 3-year, 10-month-old boy who appeared in an emergency room with scald burn on his left upper limb and left thigh produced by hot water, his total body surface area (TBSA) was about 10%. Multiple dressings were changed once weekly and most of the thigh burns had epithelized after two weeks. The patient continued to use the methacrylate powder and after another two weeks his thigh burns were completely epithelized. At 6 weeks post-epithelization, the patient was checked, a soft and flexible scar over the left thigh was seen. (12)

The second patient was a 10-year-old boy presented with a small pot of hot oil upended on his right heel. Initially, silver-based foam dressing was employed. His

wounds had progressed to deeper dermal burn measuring 2 by 5 cm after 2 weeks. Because the patient refused surgery at the moment, it was decided to treat the wound using methyl acrylate powder at an outpatient environment. The patient's wound healed nicely after three weeks of weekly dressing changes with methacrylate powder. The healed scar was soft and did not restrict ankle joint movement. (12)

In this study, methacrylate powder was used in 17 burn patients (2nd degree superficial and deep), their age from 3 years to 50 years old, eight of them were females and nine were males. One of them had DM and one had HTN. Time of dressing ranged from 2 weeks to 5 weeks. There were 5 patients who did not show complete healing and needed graft but other patients showed complete epithelization.

Case (1): Female 45 years with 2nd degree superficial scald burn on right foot without comorbidities. She underwent dressing with methacrylate powder 3 times. After 3 weeks she was completely healed with complete epithelization.



**Figure (1):** (A) Pre-dressing photo. (B) 2 weeks after injury. (c) After 3 weeks of dressing showing complete healing with epithelization.

Case (2): Female 28 years with gluteal pressure sore fourth degree full thickness. She was paraplegic after trauma. She underwent plastic surgery for a rotating flap to cover the defect. After one week the lateral part of the flap became ischemic and

necrosed. Debridement was done under general anesthesia of the lateral part. She refused any further surgery; she underwent dressing with methacrylate powder for 5 times. After 5 weeks healthy epithelium was formed.



**Figure (2):** (A) Preoperative photo. (B) After one week of surgery. (c) 3 weeks of dressings. (D) 5 weeks of dressings.

Case (3): Female 40y diabetic with 2nd degree scald burn on right foot. She underwent dressing with methacrylate

powder for 4 times. After 1-month healthy epithelium was formed.



**Figure (3):** (A) Pre dressing photo. (B) Showing complete healing.

Case (4): male 29y with 2nd degree superficial chemical burn on left leg without comorbidities. He underwent dressing with

methacrylate powder for 6 times. After 5 weeks he was completely healed.



**Figure (4):** (A) pre dressing photo. (B) 2 weeks of dressings. (c) 4 weeks of dressing. (d) 1.5 month later.

Case (5): Male 55y with raw area on the left thigh after trauma. The patient was hypertensive and diabetic. He was smoker.

He underwent dressing with methacrylate powder once. Healing appeared after one week

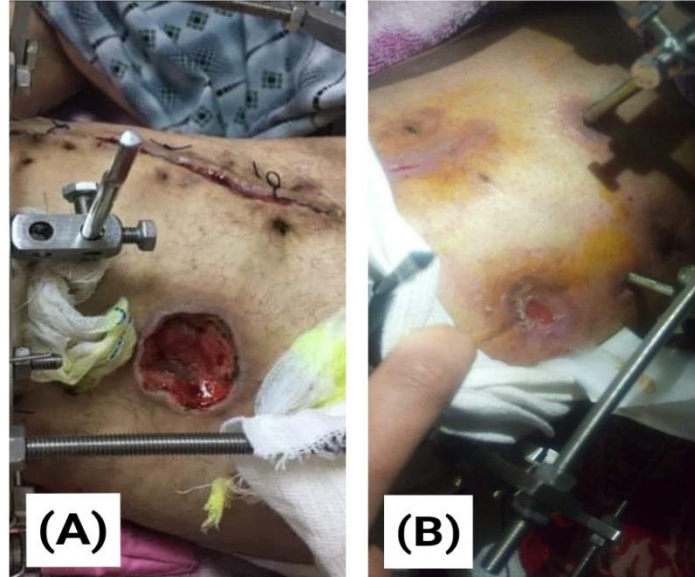


Figure (5): (A) Pre dressing photo. (B) after one week of dressing.

## Conclusions

In this study, methacrylate powder dressing was used in 30 patients with very good results and minimal complications. Patients appreciated its added comfort, reduced pain, extended wear time and ease of application allowing the wound to heal without disturbing the wound bed with frequent dressing changes and reducing the risks of surgery, but multiple dressings increasing cost. It is used in patients with clean wounds with healthy granulation tissue, patients with 2nd and 3rd degree burn, post traumatic,

pressure sores with complete healing and minimal complications. It should be considered in wounds with expected long duration of healing with traditional methods and in patients who refused surgery to cover their raw area. Proper selection of patients is a must as it is a costly method of dressing.

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