

## Original paper

# Upper & Lower Limbs Early Deep Burn Wound Excisions and Grafting Aided by Methylene Blue

Qutaiba A . Yassin, Aasem M. Al- byati, Mohammed M. Wais

## Abstract

**Background:** Deep burn involve upper and lower limbs may lead to functional problems, interfere with patients life style, increase burn morbidity and mortality which also correlate to burn wound infection and septicemia, early burn excision and autografting minimize this risk, excision of burn wound need precise demarcation of non viable eschar tissue from underlying viable tissue. Methylene Blue using aid in staining of non viable burn eschar by blue color and not staining underling viable tissue this will provide precise demarcation of nonviable tissue and facilitating wound excision and grafting thus will increase graft take and dramatically decrease risk of burn wound infection and improve patients survival

**Objectives:** To evaluate early surgical excision of upper & lower limbs deep burn (deep second degree & third degree) & autograft aided by Methylene Blue with short term follow up.

**Patients and Methods:** In this study 28 patients included, 16 males and 12 females, age range from 10 years to 40 years, were treated by early surgical excision of burn wound aided by Methylene Blue staining between April 2014 to October 2015 in Azadi teaching hospital in Kirkuk city.

**Results:** All patients have single stage of early surgical excision of burn wound aided by Methylene Blue staining and autograft ; family and patients satisfaction were taken in consideration and almost all showed satisfaction, assessment of the results by the surgeon was also accepted in all of the cases, 71.4% of the graft patients have more than 80% graft take .Only 4 patients (14.2%) in this study had minimal postoperative complications.

**Conclusion:** early surgical excision of deep upper & lower limbs burn wound aided by Methylene Blue staining and autograft is a reasonable treatment option for deep burn of upper and lower limbs, this type of deep burn lead to functional and aesthetic problem and also interfere with patients life style, using this technique improve graft take and decrease hospitalization and risk of morbidity and mortality of burn trauma.

**Keywords:** Methylene Blue, eschar and autograft.

## Introduction

Operative wound management consider as advance burn treatment which is majorly based on and used especially in Patients with Large and deep burns area excision and graft can be lifesaving<sup>(1)</sup>. The Primary factors affect mortality following thermal injury are extent of burn, age of the patient ,depth of burn and associated medical or surgical illness. Burn depth

is also influence long term aesthetic and functional results.<sup>(2)</sup> After 2 to 6 weeks eschar of deep burns start by gradual separation due to physiological process induced by collagenase production from bacteria and mechanical process by daily debridement<sup>(3)</sup>. When wound bed get ride from eschar and other debris, with improvement of patients general condition the healthy granulation tissue start to cover wound bed if its relatively uninfected, then split-

thickness skin grafts can be applied, this process may last up to 8 weeks after burn injury, and more than half of the grafted area might be lost, and repeated grafting may be needed to cover the wound.<sup>(4)</sup> Surgeon assessment of tissue Viability during tangential excision and graft is by noticing punctuate capillary bleeding, which is not noticed during tourniquet if used in extremities burn, while blood loss is extensive when the tourniquet is deflated.<sup>(2)</sup> One of the major causes of graft failure is inadequate eschar excision, which results in enlargement of the total area of open wounds with the addition of graft donor areas and inevitable subsequent skin graft operations.<sup>(5)</sup> precise identification depth of burn wound considered as crucial step because aggressive eschar excision will lead to excision of normal underlying tissue and increase bleeding during procedure that may affect the general condition intraoperatively and increase morbidity and mortality postoperatively.<sup>(6)</sup> Methylene blue had been use in medicine due to its antiseptic properties and when apply the blue color will stain only dead tissue while change to colorless in the presence of active enzymes, thus indicating living cells.<sup>(7)</sup> Patients with G-6-PD deficiency and renal failure both are contraindicated to use Methylene blue due to high risk for hemolytic anemia and it excreted by

the kidneys.<sup>(8)(9)</sup> Methylene blue application can provide a precise marker of depth burn and this become a subject of primary goal for surgeons.<sup>(10)</sup> In our clinical study, we evaluate the reliability of a practical method in which methylene blue is used for predicting burn depth in both upper and lower limbs during the early tangential excision stage decreasing overall mortality and morbidity of burn trauma.

## Material and methods

**Patients:** We conducted a prospective study, of a total number of 28 patient (16 males and 12 females) under the age of 40 years (10 years to 40 years age) with deep burn lesser than 35% involving upper and lower limbs, in Azadi teaching hospital burn center in Kirkuk city for early tangential excision using soaked gauze with 5% methylene blue (5g methylene blue powder in 100ml distil water) applied by dressing 12 hours preoperatively to predict burn wound depth associated with an autograft procedure. Those patients were selected, evaluated and operated upon during the period from April 2014 to October 2015. Their ages were ranging between 10 years to 40 years), as shown in table 1.

From these patients 16 were males while 12 were females, as shown in table 2.

**Table 1.** Number and percentage of patients according to their ages.

Age of patient	No. of Case	Percentage
less than 20 years	18	64.2 %
20-40 years	10	35.8%

**Table 2.** Number and percentage of patients according to their gender.

Gender of patient	No. of Case	Percentage
Male	16	57.1%
Female	12	42.9%

**Aim of study:** To evaluate early tangential excision of deep burn(deep second & third degree) of upper & lower limbs using methylene blue to predict burn wound depth associated with an autograft procedure with short term follow-up monitoring.

**Preoperative measures:** Preoperative evaluation in all 28 patients included medical history, a complete physical examination, thorough history and physical examination, and these were including the following:

**Personal data:** Age, sex, residency, family history.

**Clinical data:** Collected information about patient associated illnesses, smoking, drug use and medication history, and family history. Diagnosis of burn percent, depth, location, preoperative photograph were taken to all patient.

**Investigations:** Routine blood investigation and blood count and complete blood picture and biochemistry, renal and liver function tests. Prothrombin time and partial thromboplastin time .One to three pints of blood were prepared for those patient with marginal level of hemoglobin and for those with large burn percent and all the patients were checked by anesthetist.

All cases were operated under general anesthesia , with oral endotracheal intubation and patient placed in supine or prone position, the involved area prepared and draped, and surgical approaches were vary according to size, location and status of surrounding tissue; in general surgical approaches were include the following:

**Surgical technique:** Surgical approach was by early tangential excision using 5% methylene blue for 12 hours to predict burn wound depth. The blue color-stained eschar tissues were excised by deepening the excision until the unstained tissue border reached, using bipolar electrocautary for hemostasis and coagulation, then meshed or sheet split

thickness skin graft applied to cover the excised areas followed by dressing with Vaseline-impregnated gauze.

#### **Post-operative measure:**

Dressing changed at third- post-operative day with greased gauze applied on the wound with elastic bandage then change dressing done every alternative day. Antibiotics were continued for five days postoperatively, usually patients were discharged on the 7th postoperative day. Stitches and staple were removed on the 10th post-operative day. The patients were followed up (1 to 5 months post operatively) for the evaluation.

#### **Results**

28 patients included 16 male and 12 female. Age range from 10 years to 40 years. Mean follow-up time was three months (range, 1 month to 5 months).

The patient divided to three group according to graft take, first group > 75% take, second group 35-75% take, and third group <35% ,and mean graft take was 81.33%, p value <.0001 as shown in table 3.

Patients and parents concern were variable 78.5% of them mainly concerned by functional results, 10.75% mainly concerned and afraid from post burn contracture and deformities and 10.75% were concerned on the aesthetic end result as shown in table 4.

All patients had single stage burn excision and auto-graft; There were no significant wound complications. Most parents and patients were satisfied after the surgery. Only 4 patients (14.2%) in this study had postoperative complications as shown in table 5. Some of the patients results are shown in figure 1, 2, 3, 4, and 5.

## Discussion

Deep burn injuries involving upper and lower limbs can lead to functional impairment of involved site and burn injuries occurring in all age groups.<sup>(12)</sup> Up to 6 weeks post burn might be needed for complete burn eschar separation in deep thickness burns.<sup>(3)</sup> Thus increase period of hospital stay and hospitalization cost, until wound bed ready for split-thickness skin grafts were then applied.<sup>(13)</sup>

Conservative treatment of deep burns wound treatment may associated with risk of wound contamination and infection which might ended by septicemia, this risk also correlated to percent burn, depth and associated medical illness.<sup>(14)</sup> 15 out of the 28 patients included in this study had hand and upper limbs burn. 13 patients had foot and lower limbs burn; multidisciplinary team approach were carry out the decision early surgical excision and grafting, after assessment by the anesthesiologist. In both hand and foot burn Tourniquet were applied which aids in hemostasis and the excision considerably. Technical difficulties caused by bleeding during excision were accepted and not interfere with skin graft

application and this agreed with Devgan et al.<sup>(15)</sup> and Janzekovic et al.<sup>(16)</sup> In our study variable blue color tone were observed (fig 1. C) after applying sterile 5% solution of Methylene blue ,dark blue staining referred deep burn area and lighter blue staining referred to less depth ,this help to identify the variable depth of burned area give precise excision depth of dead eschar, and this agreed with Celikoz et al.<sup>(17)</sup> and Heimbach et al.<sup>(18)</sup> in which they use the same method.

In all patients, healing was uneventful with acceptable graft take. The postoperative outcomes were very satisfactory and decrease length of hospital stay up to 2-3 weeks. After an average follow-up of three months (range 1-5 months), assessment of the results by the surgeon was very accepted in all of the cases. Patients and families satisfaction were good results. Overall post-operative complications rates in our study were 14.2% although most of them were non-significant(2 case staple abscess and 2 case partial graft loss due to infection) nearly the same results were obtained by other study done by Cartotto et al.<sup>(19)</sup>, which was 11.11%, and other study done by Celikoz et al.<sup>(17)</sup>.

**Table 3.** Number and percentage of patients according to graft take:

Percent of graft take	No. of Case	Percentage
>75%	20	71.4%
35-75%	6	21.4%
<35%	2	7.2%

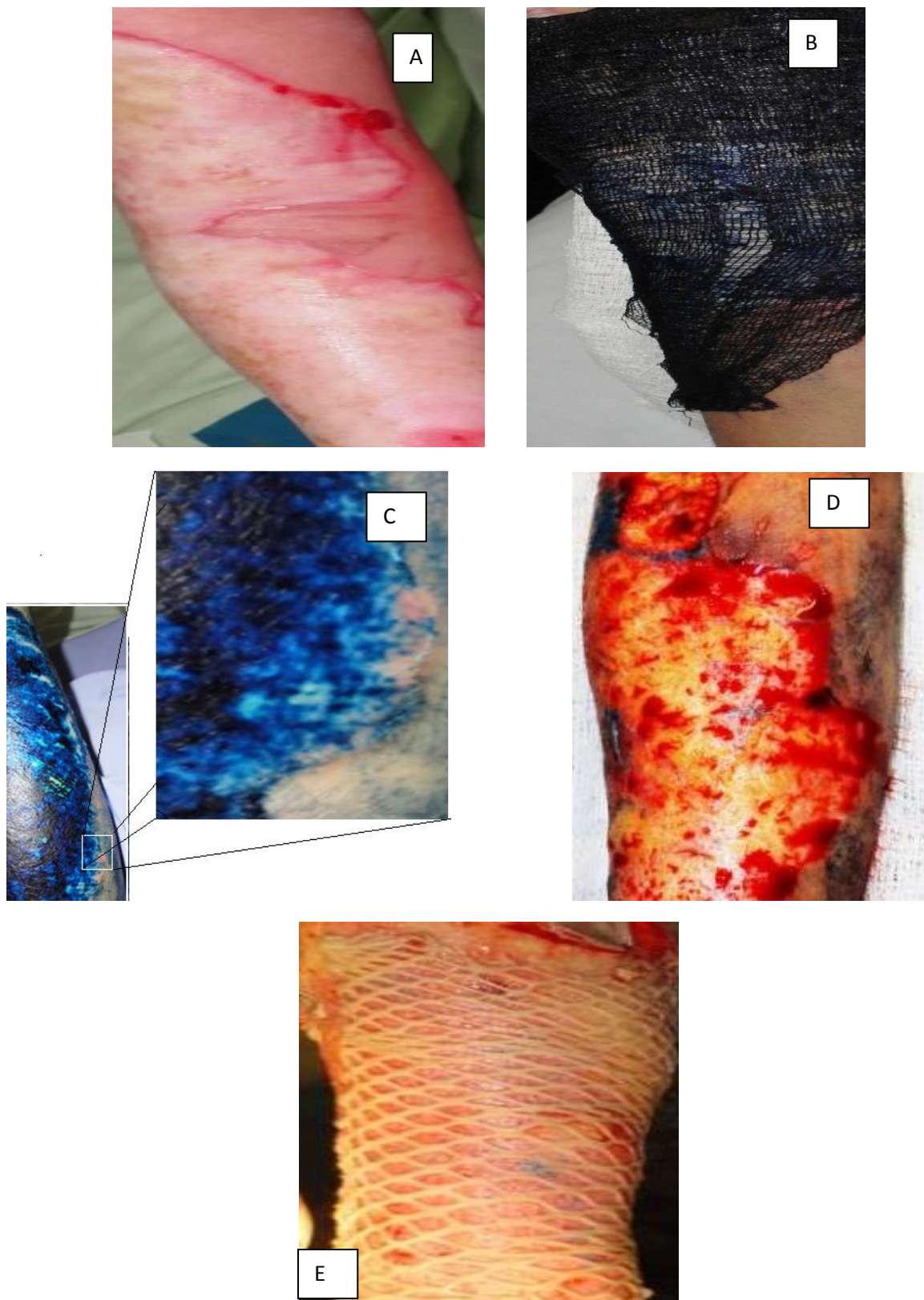
**Table 4.** Number and percent of major family and patients concern.

Patients and Parent concern	No. of Cases	Percentage
Functional	22	78.5%
Complication	3	10.75%
Others	3	10.75%

**Table 5.** Postoperative complications

Postoperative complications	No. of the Cases	Percentage
Staple abscess	2	7.1%
Partial graft loss	2	7.1%
Total	4	14.2%

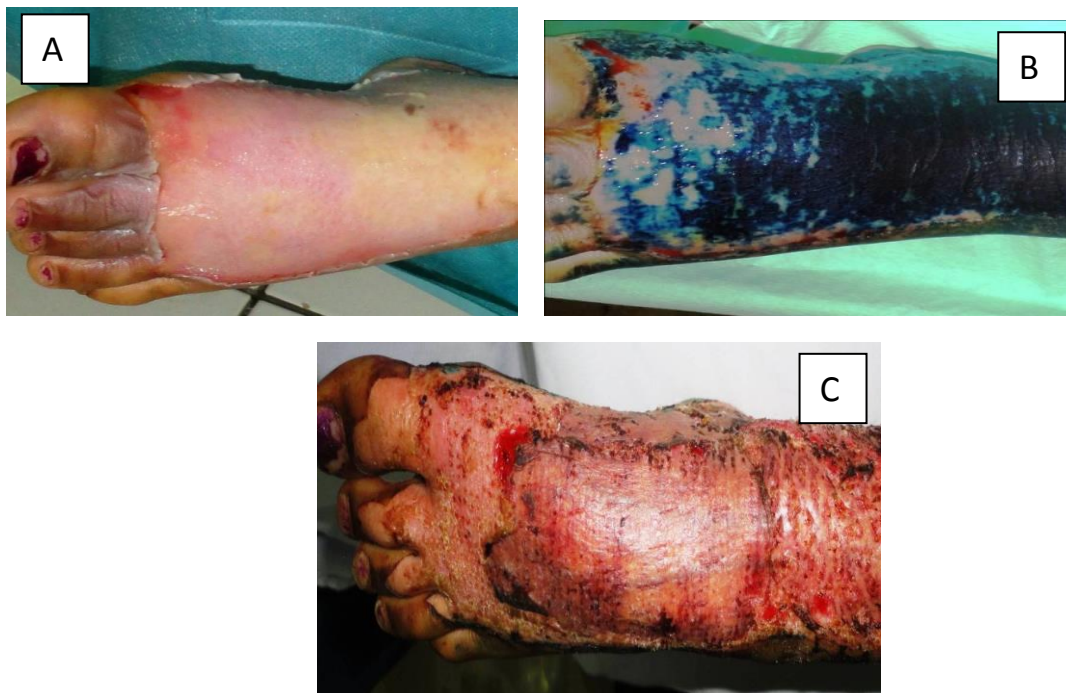




**Figure 1.** shows method of treatment (A-E) (A) Preoperative photo. (B) Applying methylene blue for 12 hours.(C) Blue color Variability according to burn depth. (D) Complete Eschar excision. (E) Applying mesh graft.

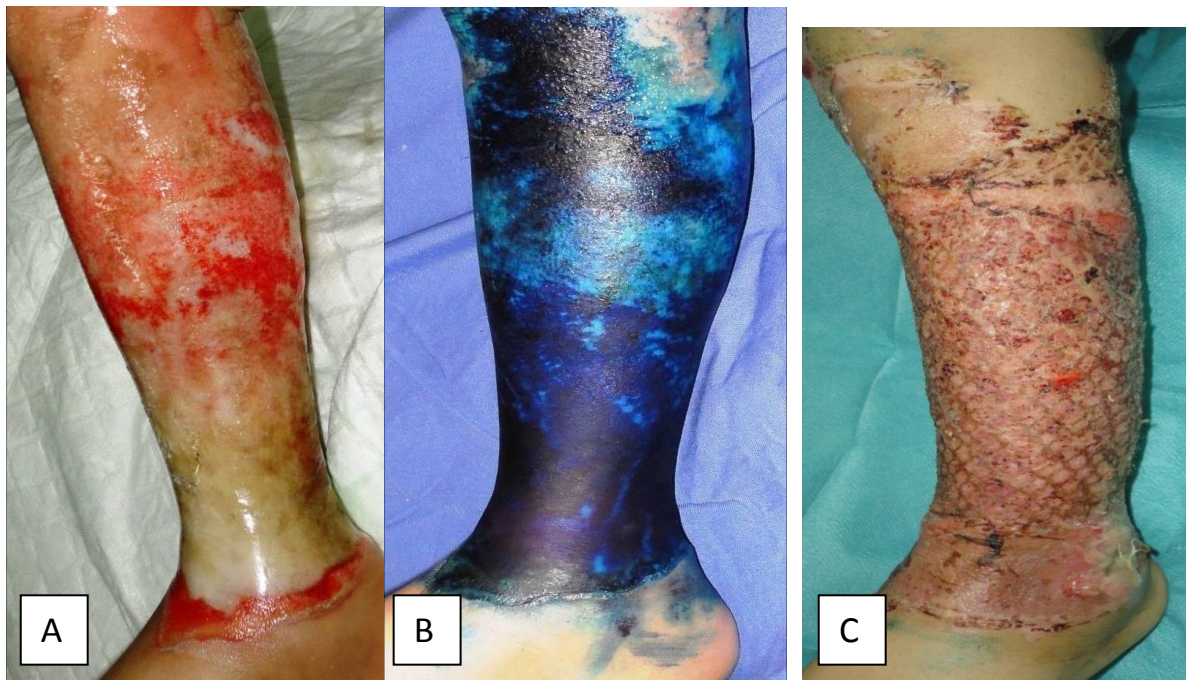


**Figure 2. Hand burn (A) preoperative photo. (B) Methylene Blue staining photo. (C) postoperative photo.**



**Figure 3. Foot burn (A) preoperative photo. (B) Methylene Blue staining photo. (C) postoperative photo.**





**figure 4. leg burn (A)preoperative photo. (B) Methylene Blue staining photo. (C)postoperative photo.**



**figure 5. leg burn (A) preoperative photo. (B) Methylene Blue staining photo. (C) postoperative photo.**

## Conclusion

Methylene blue trend is useful technique which short hospital admission for patients with deep burn that involve upper and

lower limbs, this type of deep burn lead to functional and aesthetic problem and also interfere with patients life style, it also enabling surgeons to determine burn depth and increase graft take, decrease

hospitalization and risk of morbidity and mortality of burn trauma.

## References

1. Lawrence JC, Carney SA. Tangential excision of burns: studies on the metabolic activity of the recipient areas for skin grafts. *British journal of plastic surgery*. 1973 Apr 1;26(2):93-100.
2. Roy M. Kimble, Tangential Debridement, Mark S. Granick, Richard L. Gamelli. *Surgical wound healing and management/ Informa Healthcare USA, New York, 2007 /page (46).*
3. Tam N. Pham, Nicole S. Gibran ,and David M. Heimbach, Evaluation of burn wound: management decisions. David N Herndon, Total Burn Care/third ed. SAUNDERS, ELSEVIER, USA, 2007 chapter-10/page121.
4. Jackson D.M.: Historical review of the use of local physical signs in burns. *Br. J. Plast. Surg.*, 23: 211, 1970.
5. Davies M., Adendorff D., Rode H, van de Reit I.S.: Coloring the damaged tissues on the burn wound surface. *Burns*, 6: 156, 1980.
6. Kahn AM, McCrady VL, Rosen VJ. Burn wound biopsy. Multiple uses in patient management. *Scand J Plast Reconstr Surg*. 1979;13:53–56.
7. Li XS. Use of methylene blue in tangential excision of burn wounds. *Zhonghua Wai Ke Za Zhi*. 1983; 21:138–139.
8. Cope O, Laugohr H, Moore FD, Webster R. Expeditious care of full-thickness burn wounds by surgical excision and grafting. *Ann Surg* 1947; 125:1–22.
9. Gray, D., Pine, R.W., Harner, T.J., Marvin, J.A., Engrav, L.H., Heimbach, D.M.: Early excision versus conventional therapy in patients with 20 to 40 percent burns. *Am. J. Surg*. 144:76, 1982
10. Stan Monstrey, Henk Hoeksema, Jos Verbelen, Ali Pirayesh, Phillip Blondeel, Assessment of burn depth and burn wound healing Potential, [www.elsevier.com/locate/burns](http://www.elsevier.com/locate/burns). *BURNS* 34 (2008) 761 – 769 .
11. Yulia Galagan , Wei-Fang Su , Reversible photo reduction of methylene blue in acrylate media containing benzyl dimethyl ketal . *Journal of Photochemistry and Photobiology A: Chemistry* 195 (2008) 378–383.
12. Eric Wolak, Faera L. Byerly, Tim Mason and Bruce A. Cairns. Methemoglobinemia in Critically Ill Burned Patients. *AJCC*. 2005. Volume 14, No. 2.
13. M.A. Altintas, A.A. Altintas, K. Knobloch, M. Guggenheim, C.J. Zweifel, P.M. Vogt. Differentiation of superficial-partial vs. deep-partial thickness burn injuries in vivo by confocal-laser-scanning microscopy . *BURNS* 35 (2009 ) 80– 86.
14. Holm M. Mayr J. Tegeler A. Becker.U. Pfeiffer W. Muhlbauer Laser-induced fluorescence of indocyanine green: plastic surgical applications *Eur J Plast Surg* (2003) 26:19–25.
15. Lara Devgan, Satyanarayan Bhat , S. Aylward, and Robert J. Spence, MD, FACS, Modalities for the Assessment of Burn Wound Depth, *Journal of burns and wounds*, 2006, Volume 5.
16. Janzekovic Z. A new concept in the early excision and immediate grafting of burns. *Journal of Trauma*. 1970; 10:1103–1108.
17. Celikoz B, Deveci M, Nisanci A., Early Tangential Excision With The Guidance Of Methylene Blue Application, *Annals of Burns and Fire Disasters* -1999, vol. xii – no. 4.
18. David Heimbach, M.D., Loren Engrave, M.D., Baiba Grube, M.D., and Janet Marvin, R.N., M.N, Burn Depth: A Review *World Journal of Surgery\by the international de Chirurgic\ World J. Surg*. 1992, 16, 10-15.
19. Robert Cartotto, Melinda A. Musgrave, Massey Beveridge, and Manuel Gomez, Minimizing Blood Loss in Burn Surgery. *J Trauma*. 2000; 49:1034 –1039.