

## Effect of Umbilical Catheter Fixation Using Tegaderm versus Hydrocolloid Dressing and Safe Removal on Abdominal Skin Condition among Preterm Neonates

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**Abstract:** Umbilical catheterization (UC) is one of the most frequent procedures that are performed in neonatal intensive care units (NICUs). Fixating such catheters on the abdominal skin of the preterm neonates usually is associated with skin damages. Using special types of dressings such as Tegaderm or hydrocolloid dressing as skin barrier in addition to following a safe technique in removing the adhesive materials used in umbilical cord fixation are the cornerstones in protecting the preterm neonates' skin. **Objective:** The aim of this study was to identify the effect of umbilical catheter fixation using Tegaderm versus Hydrocolloid dressing and safe removal on abdominal skin condition among preterm neonates. **Research Design:** A quasi-experimental research design was used. **Setting:** The study was conducted in the Neonatal Intensive Care Unit of Maternity University Hospital at El-Shatby. **Subjects:** A convenient sample of 90 preterm neonates who were newly admitted to NICU, required umbilical catheterization and free from abdominal skin breakdown comprised the study subjects. **Tools:** One tool was used to collect necessary data namely; Neonatal Skin Condition Scale (NSCS). **Results:** The study revealed that 73.3% of the preterm neonates of both the Tegaderm and Duoderm groups maintained their healthy skin at catheter removal day compared to none of the preterm neonates in the control group (0.0%). On the contrary, 83.3% of the neonates of the control group developed severe skin damage at catheter removal day. The difference between neonates' abdominal skin condition of the three groups was statistically significant ( $P=0.000$ ). No relation were found between the abdominal skin condition and the gestational age of the preterm neonates, the total duration and frequency of umbilical catheter change among both Tegaderm and Duoderm groups. **Conclusion:** It can be concluded that using both Tegaderm and hydrocolloid dressing in fixating the umbilical catheters and removing them safely was effective in minimizing the occurrence of abdominal skin breakdown among preterm neonates even those who were extremely preterm regardless the frequency of changing the UCs fixation. **Recommendations:** The current study recommended that neonatal nurses should use either Tegaderm or hydrocolloid dressing in umbilical catheter fixation and follow the appropriate technique in adhesive tape removal.

**Keywords :** Preterm neonates, Tegaderm, hydrocolloid dressing, Duoderm, abdominal skin damage.

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### I. Introduction

Preterm neonates are those neonates who are born before completing the 37 weeks of gestation<sup>(1)</sup>. The rate of mortality and morbidity among those neonates is high. According to the World Health Organization (2016)<sup>(2)</sup> prematurity was responsible for nearly one million deaths. Prematurity may also lead to many life-threatening conditions that frequently require admission to the Neonatal Intensive Care Unit (NICU), where a readily vascular access should be inserted<sup>(1,3)</sup>. Umbilical catheterization provides a reliable mean for emergency vascular access in the critically ill preterm neonates. The umbilical cord contains two small arteries and one large vein<sup>(3)</sup>. Umbilical catheters (UCs) could be inserted arterial, venous or both of them. The insertion procedure is performed within the first 24 hours of life as the ductus venosus starts to close once the umbilical cord is clamped and cut. The umbilical arteries begin to constrict and close within minutes after birth, while the vein retains some degree of patency for up to 2 weeks of life<sup>(4)</sup>.

Umbilical catheterization is the easiest way of obtaining vascular access in preterm neonates as it allows the direct visualization of the vessels being catheterized. Umbilical catheters are frequently used to administer emergency medications, fluids, transfusion therapy and parenteral nutrition. They can be also helpful in obtaining blood samples and monitoring blood pressure. Such catheterization is considered the best way for performing exchange transfusion in case of severe hyperbilirubolemia. However, catheterization of the umbilical artery is advisable when frequent monitoring of arterial blood gases is indicated<sup>(3-6)</sup>.

An umbilical vessel catheter insertion is contraindicated in the presence of omphalus, peritonitis, abdominal distention or any lesion of the abdominal skin. It should be also avoided when a possibility of intestinal hypoperfusion or necrotizing enterocolitis exists<sup>(4)</sup>.

Adequate fixation of UCs is important to avoid the occurrence of the catheter displacement and malposition of its tip, with consequent poor sampling and infusion and increased risk of vascular thrombosis. In addition, catastrophic hemorrhage can occur if the catheter falls out. Securing life support devices, such as, UC on fragile skin of the preterm neonates presents a challenge and a dilemma. The challenge is how to secure UC to the preterm neonates without causing iatrogenic abdominal skin damage<sup>(7)</sup>.

The fragile preterm neonates' skin is characterized by diminished cohesion between the dermis and epidermis. Thin stratum corneum layer which is the outermost layer of the epidermis is largely responsible for the vital barrier function of the skin that protect the underlying tissue from infection, dehydration, chemicals and mechanical stress.<sup>(7, 8)</sup> So, having few layers of these cells results in immaturity of the barrier function and increase the risk of stripping i.e. skin damage caused primarily by adhesives application. Stripping is commonly aroused from chemical and physical properties of the adhesive materials, improper technique of application or injudicious removal that separates the epidermis from dermis<sup>(6, 9)</sup>.

The abdominal skin of the preterm neonates' could be protected by applying barriers to prevent skin damage caused by adhesive tapes such as hydrocolloid dressing "Duoderm Extra thin". This type of dressings consists of flexible, polyurethane, outer foam layer and adhesive skin contact layer that contain a moisture-absorbing hydrocolloid material<sup>(9, 10)</sup>. It reduces the risk of further skin breakdown due to friction and it does not cause trauma on removal as well. Furthermore, UC could be stabilized by using Tegaderm Transparent film dressings. This kind of dressing consists of a thin film with a hypoallergenic, latex-free adhesive that gently and securely adheres to skin. It is sterile, transparent and waterproof type of dressings. In addition, it provides a barrier to external contaminants. Its transparency facilitates assessing the underlying umbilical catheter.<sup>(11-14)</sup>

Recently, nurses' awareness of problems resulting from adhesive tape use in NICU is increased, but they have limited options for reducing adhesive-related injuries while maintaining the optimal adherence of life support devices. Neonatal nurses could prevent such injuries by minimizing adhesive tape use whenever possible, using small pieces and delaying the removal of adhesive tapes including Tegaderm and Duoderm, if possible, until their adherence is reduced<sup>(7, 14, 15)</sup>. Adhesive removers are solvents that sometimes used to facilitate adhesive tapes removal and reduce discomfort and skin disruption. There are three main types of adhesive removers namely, Alcohol/organic-based solvents, Oil-based solvents, and Silicone-based removers. Alcohol/organic-based solvents contain hydrocarbon derivatives or petroleum distillates<sup>(16)</sup>. So, toxicity is a major adverse effect associated with the application of such topical substances. The risk of toxicity increased in preterm neonates because of their under-developed skin and increased skin permeability in addition to immature hepatic and renal function<sup>(17)</sup>. Oil-based solvents, such as, Mineral oil (Paraffin based) and petrolatum products may be helpful in removing adhesives but they cannot be used if reapplication of adhesive tape in the same site is needed<sup>(15)</sup>. According to Lund (2013)<sup>(18)</sup>, Silicone-based remover is one of the safest medical adhesive removers.

One of the crucial roles of the neonatal nurses in preventing adhesive related injuries is to remove it in a safe manner. In order to successfully remove the adhesive tape without causing neonatal skin damage, nurses should soak the adhesive tape using warm water prior to its removal<sup>(15)</sup>. They should also remove the adhesive tape very slowly and carefully, where it should be folded back unto itself parallel to skin surface instead of the straight-peeling method (90°)<sup>(19)</sup>. Nurses should support the skin surface next to the adhesive tape simultaneously with continuous wetting of the adhesive-skin interface with water soaked cotton balls. Alternatively, neonatal nurses could also use mineral oil or petrolatum ointment to loosen the adhesive tape and facilitate its removal with fewer traumas<sup>(20)</sup>.

## **II. Aim of the Study**

**The aim of the present study is to identify the effect of umbilical catheter fixation using Tegaderm versus Hydrocolloid dressing and safe removal on abdominal skin condition among preterm neonates.**

### **Research Hypotheses**

1. Preterm neonates whose umbilical catheters are fixed with Tegaderm and safely removed exhibit less abdominal skin damage than those who do not.
2. Preterm neonates whose umbilical catheters are fixed with hydrocolloid dressing and safely removed exhibit less abdominal skin damage than those who do not.
3. Preterm neonates whose umbilical catheters are fixed with hydrocolloid dressing exhibit less abdominal skin damage than those whose umbilical catheters are fixed with Tegaderm.

### **Research Design**

A quasi-experimental research design was used.

### **Settings**

The study was conducted in the Neonatal Intensive Care Unit of the Maternity University Hospital at El-Shatby.

### **Subjects**

- A convenient sample of 90 preterm neonates who fulfilled the following criteria comprised the study subjects:
  - Newly admitted to NICU.
  - Required umbilical catheterization.
  - Free from abdominal skin breakdown.
- Preterm neonates who meet the inclusion criteria were randomly assigned to three equal groups, each group consisted of 30 preterm neonates:
  - **Group 1:** Preterm neonates received Tegaderm fixation of umbilical catheter.
  - **Group 2:** Preterm neonates received hydrocolloid dressing as a skin barrier underneath the bridge fixation of umbilical catheter.
  - **Group 3:** Preterm neonates received the routine fixation method of the unit.

### **Tools**

**One tool was used to collect the necessary data.**

#### **Neonatal Skin Condition Scale (NSCS)**

This scale was developed by Lund et al. (2007)<sup>(21)</sup>. It is originally designed to provide a general estimate of overall neonatal skin condition. The assessment and scoring system of the tool were modified. The modified tool was used to assess neonates' abdominal skin only i.e., adhesive tape area only. It consisted of three items: dryness, erythema and breakdown. Each item had three points Likert Scale (1-3) as follows:

#### **Dryness:**

- Normal, no signs of dry skin (1)
- Dry skin, visible scaling (2)
- Very dry skin, cracking /fissures (3)

#### **Erythema**

- No evidence of erythema (1)
- Visible erythema, (<50% adhesive tape area) (2)
- Visible erythema, (≥50% adhesive tape area) (3)

#### **Breakdown**

- No evidence of breakdown (1)
- Small, localized areas of breakdown (2)
- Extensive breakdown (3)

The total scores of **Neonatal Skin Condition (NSC)** ranged from 3 to 9, where the score of 3 represents perfect skin condition and 9 represents the worst skin condition. The categories of the total score was modified as follows: 3 represents healthy skin condition, 4-6 represent moderate skin damage and 7-9 represent severe skin damage.

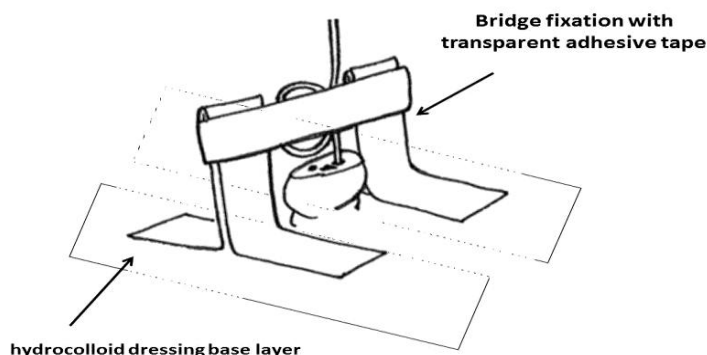
Characteristics of the neonates such as; sex, birth weight, gestational age and diagnosis on admission in addition to the duration of catheterization and Frequency of changing the dressing used in umbilical catheter fixation were attached to this tool.

### **III. Method**

1. An official approval for conducting the study was obtained from the director of the study setting after explaining its purpose.
2. The tool was submitted to a jury of five experts in pediatric nursing field for its content validity. Based on their comments; necessary modifications were done. The validity was 100%.
3. The reliability of the tool was ascertained by measuring the internal consistency of their items using Cronbach alpha coefficient. The tool was reliable as  $\alpha = 0.94$ .
4. A pilot study was carried out on nine catheterized preterm neonates (10%) from the previously mentioned setting to test the feasibility, applicability and clarity of the research tool and no modifications were done. These neonates were excluded from the total study subjects.
5. The neonates of the three groups were initially assessed in the application day of catheterization for their characteristics and abdominal skin condition.

6. **For preterm neonates in the Duoderm group** the bridge fixation of the umbilical catheter with hydrocolloid dressing base layer was applied as follows:

- The abdominal skin of the preterm neonates was cleaned and dried.
- Two strips of Duoderm were cut in rectangle shape and applied to both sides of the umbilicus.
- Two long strips of a transparent adhesive tape (Transpore) were folded into itself where the sticky sides facing each other than attached together leaving the last parts not attached.
- The last parts of the tape were fitted over the Duoderm to form vertical tape posts
- Umbilical catheter lines were coiled and secured across the tape posts to make a bridge.



7. **For preterm neonates in the Tegaderm group :**

The umbilical catheter line was coiled and fixed over the neonate's abdomen with Tegaderm dressing directly on the preterm neonates' skin.

8. **Safe Adhesive Tape Removal Technique**

- Tegaderm and hydrocolloid dressings were soaked with water before attempting to remove them. Then they slowly and carefully folded back parallel to the skin surface.
- Skin surface next to the dressings were supported, while continuously wetting the adhesive-skin interface with cotton ball that is soaked with water and paraffin oil to loosen the tape.

9. **Both types of dressings were changed when they become loose**

10. **For control group:**

The control group received the routine of umbilical catheter fixation method with a conventional adhesive tape that was applied directly on the neonates' abdominal skin without any barriers.

11. Every preterm neonate of the three groups was reassessed for their abdominal skin condition at each umbilical catheter removal day.
12. Comparison between the three groups regarding the occurrence of abdominal skin breakdown at completion of the study was done.

**Statistical Analysis:**

- After the data collection, they were coded and transferred into specially designed formats to be suitable for computer feeding using statistical software SPSS version 16. Following data entry, checking and verification processes were carried out to avoid any error during data entry.
- The statistical analysis was done for the data after its arrangement.

**The following statistical measures were used:**

**Descriptive Statistics:**

1. Number and percentage were used for describing and summarizing qualitative data.
2. Minimum and maximum were used for describing and summarizing quantitative data.
3. Mean ( $\bar{X}$ ) was used to measure central tendency in statistical tests of significance.
4. Standard deviation (**SD**) is an average of the deviations from the mean. It was used for measuring the degree of variability in a set of scores.

**Analytical Statistics:**

1. Kolmogorov – Smirnov test was used to examine the normality of data distribution
2. Chi-square test and Monte Carlo test were used to test the significance of results of qualitative variables
3. Comparison between means using Kruskal Wallis Test for abnormally distributed quantitative variables.

4. Intragroup comparisons of skin conditions were performed using Wilcoxon Signed Ranks Test.
5. The 0.05 level was used as the cut off value for statistical significance (e.g. significant at  $P \leq 0.05$ ).

#### IV. Results

Table 1 presents the bio-demographic characteristics of preterm neonates. The table revealed that more than half of the preterm neonates of the Tegaderm, Duoderm and the control groups were males (60%, 53.3% and 60% respectively). Regarding neonates' gestational age, it was obvious that nearly two thirds of the preterm neonates of the Tegaderm group (63.3%) and 60% of the preterm neonates in both Duoderm and the control group were very preterm neonates (their gestational age ranged from 28- < 32 weeks of gestation).

The same table also clarified that two thirds of the preterm neonates of both Tegaderm and control groups had very low birth weight (66.7% each) compared to slightly more than one third of those in the Duoderm group (36.7%).

It was also clear from the table that 46.7% of the preterm neonates in the Tegaderm group, 40% of the preterm neonates in the Duoderm group and 53.3% of the preterm neonates in the control group were diagnosed as respiratory distress.

**Table 1: Bio-Demographic Characteristics of Preterm Neonates**

Characteristics	Tegaderm Group		Duoderm Group		Control Group		Significance
	N n=30	%	N n=30	%	N n=30	%	
<b>Sex</b>							
Male	18	60.0%	16	53.3%	18	60.0%	$X^2=.364$ $P=0.833$
Female	12	40.0%	14	46.7%	12	40.0%	
<b>Gestational age</b>							
Extremely –Preterm (< 28 wks)	1	3.3%	0	.0%	1	3.3%	$MC P=0.979$
Very–Preterm (28- < 32 wks)	19	63.3%	18	60.0%	18	60.0%	
Late –Preterm (32-36wks)	10	33.3%	12	40.0%	11	36.7%	
<b>Birth weight</b>							
Normal birth weight	0	0.0%	4	13.3%	1	3.3%	$MC P=0.115$
Low birth weight	20	66.7%	11	36.7%	20	66.7%	
Very low birth weight	7	23.3%	9	30.0%	5	16.7%	
Extremely low birth weight	3	10.0%	6	20.0%	4	13.3%	
<b>Diagnosis</b>							
Respiratory Distress	14	46.7%	12	40.0%	16	53.3%	$MC P=0.045$ *
Hyaline Membrane disease	1	3.3%	4	13.3%	0	0.0%	
Prematurity	0	0.0%	0	0.0%	5	16.7%	
Jaundice	4	13.3%	4	13.3%	0	0.0%	
Congenital Pneumonia	7	23.3%	6	20%	4	13.3%	
TTN	2	6.7%	0	.0%	2	6.7%	
Neonatal Sepsis	1	3.3%	4	13.3%	2	6.7%	
CHD	1	3.3%	0	0.0%	1	3.3%	

$X^2$ : Chi-square Test

$MC P$ : Monte Carlo Test

\*Significant at  $P \leq 0.05$

Duration of umbilical catheterization and frequency of changing the dressing used in fixation are clarified in table 2. It was apparent that duration of umbilical catheter insertion to preterm neonates in the Tegaderm group and Duoderm group varied from 5 to less than 10 days (50% and 43.3% respectively) while the same duration was recognized among one third of preterm neonates in the control group (33.3%). The mean duration of umbilical catheters were  $9.20 \pm 3.708$ ,  $9.23 \pm 3.401$  and  $8.43 \pm 3.339$  for the Tegaderm, Duoderm and control group respectively. No statistical significant differences between the three groups were found.

Regarding Frequency of changing the dressing used in umbilical catheter fixation, it was clear that the dressing used in fixation of nearly half of the umbilical catheters that inserted to the preterm neonates in the Duoderm group (46.7%) and more than one third of catheters among preterm neonates in the Tegaderm group (36.7%) were not changed throughout its duration compared to none of the umbilical catheters inserted to neonates in the control group.

It was also observed that the dressing used in umbilical catheters fixation were changed three times and more among 80% of preterm neonates in control group compared to only 3.3% among both the Tegaderm and Duoderm groups. The mean number of changing the dressing used in umbilical catheter fixation for preterm

neonates in the Tegaderm, Duoderm and control group was  $0.9 \pm 0.85$ ,  $0.83 \pm 0.91$  and  $4.8 \pm 2.06$  respectively. High statistical significant difference was found between the three groups ( $P = 0.000$ ).

**Table 2: Duration of Umbilical Catheterization and Frequency of Changing the Dressing Used in Fixation**

Duration & Frequency	Tegaderm Group		Duoderm Group		Control Group		Significance
	N n=30	%	N n=30	%	N n=30	%	
<b>Duration of Umbilical Catheterization (days)</b>							
▪ <5	8	26.7%	12	40.0%	14	46.7%	$X^2=4.09$ $P=0.393$
▪ 5-	15	50.0%	13	43.3%	10	33.3%	
▪ 10 & more	7	23.3%	5	16.7%	6	20.0%	
Min-Max	3-13		3-12		2-12		<sup>KW</sup> $X^2=1.181$ $P=0.554$
Mean±SD	9.20±3.708		9.23±3.401		8.43±3.339		
<b>Frequency of changing the dressing used in umbilical catheter fixation</b>							
▪ 0	11	36.7%	14	46.7%	0	0.0%	$X^2=62.92$ $P=0.000^{***}$
▪ 1	12	40.0%	8	26.7%	1	3.3%	
▪ 2	6	20.0%	7	23.3%	5	16.7%	
▪ 3 & more	1	3.3%	1	3.3%	24	80.0%	
Min-Max	0-3		0-3		1-6		<sup>KW</sup> $X^2=52.87$ $P=0.000^{***}$
Mean±SD	0.9±.845		0.83±0.91		4.8±2.06		

$X^2$ : Chi-square Test <sup>KW</sup>  $X^2$ : Kruskal Wallis Test \*Significant at  $P \leq 0.05$  \*\*\* $P < 0.001$ .

Assessment of abdominal skin on catheter removal day among preterm neonates is illustrated in table 3. It was observed that more than three quarters of neonates in the Tegaderm and Duoderm groups (76.7% for each) had no sign of skin dryness compared to only 3.3% of those in the control group. While, half of neonates in the latter group (50%) had very dry and cracked skin (50%). In addition, 80% and 96.7% of preterm neonates in the Tegaderm and Duoderm group respectively had no evidence of erythema compared to none of those in the control group. Moreover, it was obvious that more than three quarters of preterm neonates in the control group (76.7%) developed erythema in more than 50% of the adhesive tape area.

It was also clear that all preterm neonates in the Tegaderm and Duoderm groups showed no evidence of skin breakdown at catheter removal day (100% for each). On the contrary, nearly two thirds of preterm neonates in the control group (60%) developed extensive breakdown in the area of dressing. High statistical significant differences were found between the three groups and the three areas of skin assessment namely dryness, erythema and breakdown ( $P=0.000$ ,  $P=0.000$  and  $P=0.000$  respectively).

**Table3: Assessment of Abdominal Skin on the Catheter Removal Day among Preterm Neonates of the three groups.**

Abdominal Skin Assessment	Catheter Removal Day						Significance
	Tegaderm Group		Duoderm Group		Control Group		
	N n=30	%	N n=30	%	N n=30	%	
<b>Dryness</b> Normal, no sign of dry skin	23	76.7%	23	76.7%	1	3.3%	$X^2=54.09$ $P=0.000^{***}$
Dry skin, visible scaling	7	23.3%	7	23.3%	14	46.7%	
Very dry skin, cracking /fissures	0	0.0%	0	0.0%	15	50.0%	
<b>Erythema</b> No evidence or erythema	24	80.0%	29	96.7%	0	.0%	$MC P=0.000^{***}$
Visible erythema, <50% adhesive tape area	6	20.0%	1	3.3%	7	23.3%	
Visible erythema, ≥50% adhesive tape area	0	.0%	0	.0%	23	76.7%	
<b>Breakdown</b> No evidence	30	100.0%	30	100.0%	4	13.3%	$MC P=0.000^{***}$
Small, localized areas	0	.0%	0	.0%	8	26.7%	
Extensive	0	.0%	0	.0%	18	60.0%	

$X^2$ : Chi-square Test  $MC P$ : Mont Carlo Exact Probability \*Significant at  $***P < 0.001$ .

Table 4 illustrates the effect of umbilical catheter fixation method on neonatal abdominal skin condition on the catheter removal day. It was obvious that skin condition of nearly three quarters of preterm neonates in the Tegaderm and Duoderm groups (73.3% for each) remained healthy on the catheter removal day compared to none of those in the control group. On the contrary, 83.3% of neonates in the control group developed severe skin damage on catheter removal day compared to none of the neonates in both the Tegaderm and Duoderm groups. The difference between neonates' abdominal skin condition of the three groups was statistically significant ( $P=0.000$ ).

It was also apparent that the mean score of the neonatal skin condition on the catheter removal day in Tegaderm group was  $3.43 \pm 0.78$  and  $3.27 \pm 0.45$  for Duoderm group compared to  $7.70 \pm 1.34$  in the control group and the difference was statistically significant ( $P=0.000$ ).

**Table 4: Effect of Umbilical Catheter Fixation Method on Neonatal Abdominal Skin Condition on the Catheter Removal Day.**

Abdominal Skin Condition	Catheter Removal Day						Significance
	Tegaderm Group		Duoderm Group		Control Group		
	N n=30	%	N n=30	%	N n=30	%	
<b>Healthy skin condition ( NSC=3)</b>	22	73.3%	22	73.3%	0	0.0%	$X^2=72.85$ $P=0.000^{***}$
<b>Moderate skin damage( NSC=4-6)</b>	8	26.7%	8	26.7%	5	16.7%	
<b>Severe skin damage( NSC=7-9)</b>	0	0.0%	0	.0%	25	83.3%	
Min-Max <sup>∇</sup>	3-5		3-4		4-9		$KW X^2=65.42$ $P=0.000^{***}$
Mean±SD	3.43±0.78		3.27±0.45		7.70±1.34		

$X^2$ : Chi-square Test  $KW X^2$ : Kruskal Wallis Test \*Significant at  $**P < 0.001$   $***P < 0.001$   
<sup>∇</sup> Neonatal Skin Condition (NSC) ranged from 3-9

The effect of umbilical catheter fixation method on neonatal abdominal skin condition on the catheter removal day among Tegaderm versus Duoderm groups is illustrated in table 5. The table clarified that nearly three quarters of preterm neonates in the Tegaderm and Duoderm groups (73.3% for each) had healthy skin condition on the catheter removal day and none of them developed severe skin damage. No statistically significant differences were found between the two groups.

**Table5: Effect of Umbilical Catheter Fixation Method on Neonatal Abdominal Skin Condition on the Catheter Removal Day among Tegaderm versus Duoderm group.**

Abdominal Skin Condition	Catheter Removal Day				Significance
	Tegaderm Group		Duoderm Group		
	N n=30	%	N n=30	%	
▪ Healthy skin condition	22	73.3%	22	73.3%	X <sup>2</sup> =0.00 P=1.00
▪ Moderate skin damage	8	26.7%	8	26.7%	
▪ Severe skin damage	0	0.0%	0	.0%	
Min-Max	3-5		3-4		Z <sup>MW</sup> =-0.382
Mean±SD	3.43±0.78		3.27±0.45		P=0.702

X<sup>2</sup>: Chi-square Test                      \*Significant at    \*\*P< 0.001                      \*\*\*P< 0.001

Table6 presents the effect of umbilical catheter fixation method on abdominal skin condition at the application and catheter removal day among neonates in the Tegaderm, Duoderm and control group. The table revealed that all preterm neonates in the Tegaderm and Duoderm groups had healthy skin condition on the first day of umbilical catheterization (100%). On catheter removal day, 73.3% of the preterm neonates of both groups had no changes in their abdominal skin condition and 26.7% of them showed moderate skin damage. The mean difference between application and catheter removal days was 0.34±2.39 for Tegaderm group and 0.27±2.83 for Duoderm group compared to 4.7±13.37 for the control group. No statistical significant difference was found regarding the skin condition on application and catheter removal day in the preterm neonates of both the Tegaderm and Duoderm groups (P=0.09 and 0.25 respectively) while, the difference was highly statistical significant in the control group (P=0.000)

**Table6: Effect of Umbilical Catheter Fixation Method on Abdominal Skin Condition at Application and Catheter Removal Day among the Neonates in the Tegaderm, Duoderm and control Groups.**

Abdominal Skin Condition	Tegaderm Group				Duoderm Group				Control Group			
	Application Day		Catheter Removal Day		Application Day		Catheter Removal Day		Application Day		Catheter Removal Day	
	N n=30	%	N n=30	%	N n=30	%	N n=30	%	N n=30	%	N n=30	%
Healthy skin condition	30	100	22	73.3%	30	100	22	73.3%	30	100	0	.0%
Moderate skin damage	0	0.0	8	26.7%	0	0.0	8	26.7%	0	0.0	5	16.7%
Severe skin damage	0	0.0	0	0.0%	0	0.0	0	.0%	0	0.0	25	83.3%
Mean±SD	3.0±0.0		3.43±0.78		3.0±0.0		3.27±0.45		3.0±0.0		7.70±1.34	
Mean difference	0.34±2.39				0.27±2.83				4.7±13.37			
Significance	Z <sup>Wil</sup> = -2.59    P=0.09				Z <sup>Wil</sup> = -2.24    P=0.25				Z <sup>Wil</sup> = -4.83 P=0.000***			

Z<sup>Wil</sup>= Wilcoxon Signed Ranks Test                      \*Significant at P≤0.05

The relation between the abdominal skin condition and preterm neonates' gestational age, the duration of umbilical catheterization and frequency of dressing change among preterm neonates is shown in table 7. The table illustrated that 59.1% of the very preterm neonates in Tegaderm group and 68.2% of those among Duoderm group maintained their healthy skin condition on catheter removal day compared to none of the very preterm neonates in the control group. Statistical significant difference was found between the gestational age and the abdominal skin condition in the control group only (P= 0.005).

It was clear from the same table that no statistical significant differences were shown between the total duration of umbilical catheterization and the abdominal skin condition among preterm neonates in the three groups. While, statistical significant difference was found between the frequency of changing the dressing used in umbilical catheter fixation and the abdominal skin condition among preterm neonates in the control group only (P= 0.034).



**Table 7: The Relation between the Abdominal Skin Condition and Preterm Neonates' Gestational Age, the Duration of Umbilical Catheterization and Frequency of Dressing Change among Preterm Neonates.**

Characteristics	Abdominal Skin Condition																	
	Tegaderm Group						Duoderm Group						Control Group					
	Healthy skin condition n=22		Moderate skin damage n=8		Severe skin damage n=0		Healthy skin condition n=22		Moderate skin damage n=8		Severe skin damage n=0		Healthy skin condition n=0		Moderate skin damage n=5		Severe skin damage n=25	
	N	%	N	%	N	%	N	N	N	%	N	%	N	%	N	%	N	%
<b>Gestational age</b>																		
Extremely –Preterm	1	4.5%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	4.0%
Very–Preterm	13	59.1%	6	75.0%	0	0.0%	15	68.2%	3	37.5%	0	0.0%	0	0.0%	0	0.0%	18	72.0%
Late –Preterm	8	36.4%	2	25.0%	0	0.0%	7	31.8%	5	62.5%	0	0.0%	0	0.0%	5	100.0%	6	24.0%
<b>Significance</b>	MC <sub>P</sub> =0.76						MC <sub>P</sub> =0.137						MC <sub>P</sub> =0.005*					
<b>Duration of Umbilical Catheterization(days)</b>																		
<5	7	31.8%	1	12.5%	0	0.0%	6	27.3%	0	.0%	0	0.0%	0	0.0%	2	40.0%	4	16.0%
5-	4	18.2%	3	37.5%	0	0.0%	8	36.4%	5	62.5%	0	0.0%	0	0.0%	3	60.0%	11	44.0%
10 & more	11	50.0%	4	50.0%	0	0.0%	8	36.4%	3	37.5%	0	0.0%	0	0.0%	0	0.0%	10	40.0%
<b>Significance</b>	MC <sub>P</sub> =0.420						MC <sub>P</sub> =0.251						MC <sub>P</sub> =0.144					
<b>Frequency of changing the dressing used in umbilical catheter fixation</b>																		
0	9	40.9%	2	25.0%	0	0.0%	9	40.9%	5	62.5%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
1	9	40.9%	3	37.5%	0	0.0%	8	36.4%	0	.0%	0	0.0%	0	0.0%	1	4.0%	0	0.0%
2	3	13.6%	3	37.5%	0	0.0%	5	22.7%	2	25.0%	0	0.0%	0	0.0%	3	12.0%	2	40.0%
3 & more	1	4.5%	0	0.0%	0	0.0%	0	0.0%	1	12.5%	0	0.0%	0	0.0%	21	84.0%	3	60.0%
<b>Significance</b>	MC <sub>P</sub> =0.572						MC <sub>P</sub> =0.096						MC <sub>P</sub> =0.034*					

MC<sub>P</sub>: Mont Carlo Exact Probability \*Significant at P≤0.05

### V. Discussion

Vulnerable preterm neonates who begin their life in NICUs are often subjected to many life support devices attached to them such as Umbilical catheters. These devices are secured with various types of adhesive materials. The skin of the preterm neonates is characterized by underdeveloped stratum corneum. Unfortunately, unintentional traumas to preterm neonates' skin aroused from chemical and physical properties of the adhesive materials, improper technique of application or injudicious removal. The majority of these skin injuries are preventable by conscious nursing care<sup>(1,10)</sup> Saresai et al (2011)<sup>(22)</sup> stated that the incidence of iatrogenic skin injuries in the NICUs are decreased due to adherence to the improved techniques in performing many procedures to preterm neonates but these skin injuries have not been completely eliminated. So, they recommended that the health care providers must make every effort to recognize such injuries and prevent their occurrence in the NICUs.

The results of the current study revealed that the majority of the preterm neonates in the study group whose UCs were fixed by hydrocolloid dressing (Duoderm), maintained their healthy skin on the catheter removal day. This finding could be due to the protective coating offered by the Duoderm between the epidermis and adhesive tape. This in turn helps stabilize the UCs without direct contact between the adhesive materials and preterm neonates' skin. Besides, when changing the UC fixation is indicated, the adhesive tape could be removed and applied many times without the occurrence of any skin damage due to the presence of a skin barrier. Also, the reduction of the skin damage in the Duoderm group could be explained in the light of the fact that Duoderm extra-thin dressing do not require frequent change or cause trauma on removal, especially when remained for long periods as its adhesion is lessened.

Using hydrocolloid barrier is recommended in many literatures<sup>(23-25)</sup>. The reduction in skin damage among the hydrocolloid dressing group in the present study is congruent with the findings of Li- huaXien (2014)<sup>(26)</sup> and O'neil and Schumacher (2014)<sup>(27)</sup> who concluded that hydrocolloid dressings reduce the incidence and severity of adhesive-related skin injuries in the skin of preterm neonates. Moreover Lund (2014)<sup>(28)</sup> mentioned Medical adhesive-related skin injury affecting neonates such as epidermal stripping, skin tears, and tension blisters; dermatitis reactions are reduced by using skin barriers such as hydrocolloid dressing especially when safe adhesive tape removal techniques is followed

The results of the current study revealed that the majority of the preterm neonates in the study group whose UCs were fixed by Tegaderm dressing also maintained their healthy skin on the catheter removal day. Maintenance of a healthy skin condition among the neonates in the Tegaderm group may be related to the fact that this type of dressing could be left in place for extended periods, with minimal discomfort and skin trauma especially when the dressing is properly removed. Moreover, Tegaderm dressing is breathable; i.e. it is made of semi-permeable films and can be considered as selective filter. It is occlusive to liquids, bacteria, and viruses; yet water vapor, oxygen, and carbon dioxide can easily be exchanged. So, it did not increase the risk of catheter-related bacteremia. From another perspective, Tegaderm is made with a hypoallergenic, latex-free adhesive that is gentle to the skin while holding the UC securely in place. So, it is safe, even when it is applied for long periods of time.

The results of the present study is in the same line with Arnts et al. (2014)<sup>(29)</sup> who recommended using Tegaderm dressing in fixation of central venous catheters in neonates. Moreover, Jones (2004)<sup>(11)</sup> shows the advantage of using Tegaderm dressing in covering the umbilical Catheter sites such as its gaseous permeability and vapor transmission. In addition, Gallieni (2004)<sup>(13)</sup> found significant lower bacterial counts with Tegaderm dressing after 5 days compared to the other patients whose catheter sites were covered by tape and gauze. Moreover, the researcher reported that most of patients whose catheter exit-site was covered by a Tegaderm dressings experienced less dressing changes. These results are congruent with the results of the current study were one third of the UC of the preterm neonates in the Tegaderm group were not changed and nearly one half of them were changed only one time throughout its duration.

The technique that was used in removing both the Duoderm and Tegaderm dressings may contribute in maintaining a healthy skin condition of the preterm neonates<sup>(29-32)</sup>. Moreover, the low frequency of changing the fixation umbilical catheters that were inserted to the preterm neonates in both the Duoderm and Tegaderm groups could be another possible reason for minimizing the occurrence of abdominal skin damage. This result is supported by the findings of Kuller (2001)<sup>(33)</sup> who reported that limiting the use of adhesives in addition to the use of a physical barrier, such as, Duoderm beside slow and careful removal of the adhesive tape reduced the incidence of epidermal stripping in NICUs. Additionally, Lund et al. (2007)<sup>(21)</sup> reported that using Duoderm as skin barrier leaving less visible skin trauma in preterm neonates when removed safely. Likewise, the use of skin protecting barrier is recommended by many other studies<sup>(33-35)</sup>. In this context, McNichol et al. (2013)<sup>(36)</sup> and Denyer et al. (2011)<sup>(37)</sup> recommended that using the soaked cotton balls, mineral oil or petrolatum ointment in adhesive tape removal for neonates especially preterm neonates loosen the tape and facilitate its removal with fewer traumas and pain. The nurses should support the skin surface next to the adhesive tape simultaneously with continuous wetting of the adhesive-skin interface with the water. Alternatively, the neonatal nurses could also use.

The results of the current study highlighted that more than three quarters of the preterm neonates in the control group whose UCs were fixed by conventional adhesive tape developed severe skin damage on the catheter removal day. The application of the adhesive tape directly on the preterm neonates' abdominal skin without any barrier could explain this finding. The occurrence of skin damage among those preterm neonates may be also related to the inappropriate method of removing adhesive tape including the aggressive, straight up and rapid removal without soaking the tape with any other softening agent as water or normal saline. Other possible cause of abdominal skin damage among the preterm neonates in the control group could be related to the repeated UCs fixation change.

The results of the current study showed no relation between the abdominal skin condition and the gestational age of the preterm neonates, as well as the duration and frequency of umbilical catheter change among both Tegaderm and Duoderm groups. This denotes that using both Duoderm and Tegaderm dressing was helpful in minimizing the occurrence of abdominal skin damages even in the extremely and very preterm neonates. Moreover, these types of dressings are protective to the preterm neonates' skin in spite of the long duration of catheterization or frequent change of catheters' fixation.

## **VI. Conclusion**

Based on the findings of the current study it can be concluded that using both Tegaderm and hydrocolloid dressing in fixation of the umbilical catheter was effective in minimizing the occurrence of

abdominal skin damage among preterm neonates even those who were extremely preterm regardless the frequency of changing the UCs fixation.

**Based on the findings of the current study, the following recommendations are suggested:**

- Educational programs should be provided for neonatal nurses about the umbilical catheter fixation methods and their associated complications.
- Neonatal intensive care units should be equipped with the necessary medical supplies that facilitate the application of the ideal umbilical catheter fixation methods, such as, Hydrocolloid and Tegaderm dressing.
- The Ideal umbilical catheter fixation methods should be included in the pediatric nursing curriculum to enhance students' performance.

### References

- [1]. Hockenberry M, Marilyn J. Wilson D. Wong's Nursing Care of Infants and Children. 10th ed. St. Louis: Mosby, An Imprint of Elsevier Inc.; 2015. Chapter 10, The high- Risk newborn and family; p. 336-7.
- [2]. World Health Organization. Preterm Birth. Fact sheet N 363; 2013. Available from: <http://www.who.int/mediacentre/factsheets/fs363/en/>. Retrieved on 25 July 2015.
- [3]. South M, Magnayt A. Simple method for securing umbilical catheters. Archives of Disease in Childhood 1988;751-3
- [4]. Garro A, Linakis J. Umbilical Vessel Catheterization. In: Christopher K, Henretig F. Textbook of Pediatric Emergency Procedures. 2<sup>nd</sup> ed. Philadelphia: Lippincott Williams & Wilkins; 2008. p: 481-7.
- [5]. Lund C, Osborne J, Kuller J, Lane A, Lott J, Raines D. Neonatal skin care: clinical outcomes of the AWHONN/NANN evidence-based clinical practice guideline. J ObstetGynecol Neonatal Nurs. 2001; 30(1):41-51.
- [6]. Melbourne E, MacDonald J, Mhairi G, Ramasethu S, Jayashree N. Atlas of Procedures in Neonatology. 4<sup>th</sup> ed. Washington: Lippincott Williams & Wilkins; 2007. Chapter 28, Umbilical Artery Catheterization. p 158-62.
- [7]. Sarkar R, Inamadar A. Advances in Pediatric Dermatology. Tokyo: Jaypee Brothers Medical Pub.; 2014. Chapter 3, Iatrogenic cutaneous injuries in neonates. p:24- 38.
- [8]. Steven B. Hoath, Howard I, Maibach C. Neonatal Skin Function and Structure. 2<sup>nd</sup> ed. New York: Marcel Dekker Inc.; 2013. Chapter 15, Adhesion and newborn skin. p. 299-334.
- [9]. Shimizu T, Mizutani T, Yamashita S, Hagiya K, Tanaka M. Endotracheal tube extubation force: adhesive tape versus endotracheal tube holder. Respir Care. 2011; 56(11):1825-9.
- [10]. Hokenberry M, Winkelstein M. Wong's Essential of Pediatric Nursing. 7<sup>th</sup> ed. St. Louis: Mosby; 2007. Chapter 22, Pediatric variations of nursing interventions; p. 774-6.
- [11]. Jones A. Dressings for the Management of Catheter Sites: A Review. Journal of the Association for Vascular Access 2004; 9( 1) : 26-33
- [12]. Bernatchez S. Care of Peripheral Venous Catheter Sites: Advantages of Transparent Film Dressings Over Tape and Gauze. Journal of the Association for Vascular Access. 19 (4) 2014; 256-61.
- [13]. Gallieni M. Transparent film for intravascular catheter exit-site dressings. J Vasc Access. 2004 ;5(2):69-75.
- [14]. Kalia Y, Nonato L, Lund C, Guy R. Development of skin barrier function in premature infants. J Invest Dermatol. 1998; 111(2):320-6.
- [15]. Kenner C, Lott J. Comprehensive Neonatal Care: An Interdisciplinary Approach. 4<sup>th</sup> ed. New York: Elsevier Inc.; 2007. Chapter 4, skin care practices. p. 80-9.
- [16]. Denyer J. Reducing pain during the removal of adhesive and adherent products. Br J Nurs. 2011 ; 20(15):S28-35.
- [17]. Palmer L. Prevention of skin breakdown in the pediatric intensive care unit [Published PhD thesis]. South Carolina University, Scholar Commons; 2013. p: 10- 16. Available from: <http://scholarcommons.sc.edu/cgi/viewcontent.cgi?article=2694&context=etd>. Retrieved on 5 November 2015.
- [18]. Lund C. An overview of the neonatal skin care guideline. Benioff Children's Hospital Oakland; 2013. [Internet] Available from: <http://www.nationwidechildrens.org/GD/Applications/Files/2014-neonatal-conference/day-1/5-day-1-main-breakout-1-option-b-carolyn-lund-2-overview-skin-care-guideline-lund.pdf>. Retrieved on 22 may 2015.
- [19]. Lund C. Medical adhesives in the NICU. NAINR. 2014; 14(4):160-5.
- [20]. McNichol L, Lund C, Rosen T, Gray M. Medical adhesives and patient safety: state of the science: consensus statements for the assessment, prevention, and treatment of adhesive-related skin injuries. OrthopNurs. 2013;32(5):267-81.
- [21]. Lund C, Kuller J, Raines D, E, cklund S, Archambault M, O'Flaherty P. Neonatal skin care: evidence-based clinical practice guideline. J ObstetGynecol Neonatal Nurs. 2007; 38 (1): 75-91.
- [22]. Saresai, S., Kornack, M., Walas, W, Ramanathan R. Iatrogenic skin injury in the neonatal intensive care unit. Journal of Maternal-Fetal and Neonatal Medicine 2011, 24(2), 197-203
- [23]. Byrne S, Fisher S, Fotune P, Wieteska S, Lawn C. Paediatric and Neonatal Safe Transfer and Retrieval: The- Practical Approach. London: BMJ books; 2014. Chapter 10, Securing and packaging, p.74-7.
- [24]. Sarkar R, Inamadar A. Advances in Pediatric Dermatology. Tokyo: Jaypee Brothers Medical Pub.; 2014. Chapter 3, Iatrogenic cutaneous injuries in neonates. p:24- 38.
- [25]. Steven B. Hoath, Howard I, Maibach C. Neonatal Skin Function and Structure. 2<sup>nd</sup> ed. New York: Marcel Dekker Inc.; 2013. Chapter 15, Adhesion and newborn skin. p. 299-334.
- [26]. Li- hua Xie. Hydrocolloid dressing in preventing nasal trauma secondary to nasal continuous positive airway pressure in preterm infants. World J Emerg Med. 2014; 5(3): 218-22.
- [27]. O'neil A, Schumacher B. Application of a pectin barrier for medical adhesive skin injury (epidermal stripping) in a premature infant. J Wound Ostomy Continence Nurs. 2014; 41(3):219-21.
- [28]. Lund C. Medical adhesives in the NICU. NAINR. 2014; 14(4):160-5.
- [29]. Arnts I, Bullens L, Groenewoud J, Liem K. Comparison of complication rates between umbilical and peripherally inserted central venous catheters in newborns. J ObstetGynecol Neonatal Nurs 2014; 43 (2): 205-15.
- [30]. Ligi I, Arnaud F, Jouve E, Tardieu S, Sambuc R, Simeoni U. Iatrogenic events in admitted neonates: a prospective cohort study. Lancet. 2008; 371(9610):404-10.

- [31]. Hitchcock J, Savine L. Medical adhesive-related skin injury: VADS and dressings. *Br. J. Nurs.* 2015; 24(14):S13.
- [32]. Gordon M, Montgomery L. Minimizing epidermal stripping in the very low birth weight infant: integrating research and practice to affect infant outcome. *Neonatal Netw.* 1996; 15(1):37-44.
- [33]. Kuller J. Skin breakdown: risk factors, prevention, and treatment. *Newborn and Infant Nursing Reviews* 2001; 1(1): 35-42.
- [34]. Fan S, Hwang Y, Chuang P. Improving the facial skin and oral mucosa integrity of patients with oral endotracheal intubation. *Hu Li ZaZhi.* 2005; 52(2):39-47.
- [35]. Colleen T, Butler N. Pediatric skin care: guidelines for assessment, prevention, and treatment. *Pediatr Nurs.* 2006; 32(5):443-50.
- [36]. McNichol L, Lund C, Rosen T, Gray M. Medical adhesives and patient safety: state of the science: consensus statements for the assessment, prevention, and treatment of adhesive-related skin injuries. *Orthop Nurs.* 2013; 32(5):267-81.
- [37]. Denyer J. Reducing pain during the removal of adhesive and adherent products. *Br J Nurs.* 2011 ; 20(15):S28-35.

Omnia G.Waziry. "Effect of Umbilical Catheter Fixation Using Tegaderm versus Hydrocolloid Dressing and Safe Removal on Abdominal Skin condition among Preterm Neonates. " *IOSR Journal of Nursing and Health Science (IOSR-JNHS)* , vol. 7, no.6 , 2018, pp. 44-55.