

## EFFECTS OF WRIST FIXATION BOARD IN CHILDREN ON THE COMPLICATION RATES OF PERIPHERAL VENOUS CATHETERS

### ÇOCUKLARDA KULLANILAN BİLEK TESPİT TAHTASININ PERİFERİK VENÖZ KATETER KOMPLİKASYONLARINA ETKİSİ

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#### ABSTRACT

**PURPOSE:** Peripheral intravenous catheter (PIVC) insertion is the most frequently used invasive intervention that is performed in more than 80% of hospitalized children. It is a known that seemingly innocent PIVC may result in various morbidities such as phlebitis, infection, extravasations, and may even lead to mortality. In this study, we aimed to investigate the effect of a new fixation board (wrist-ankle fixation board) on PIVC lifespan and complications rates in pediatric patients undergoing PIVC insertion in the joint area.

**MATERIAL AND METHODS:** A total of 49 patients who were treated in the pediatric surgery ward between June and July 2018 and who underwent PIVC insertion were prospectively followed. The patients were divided into the following two groups: 'Group 1' in which a wrist-ankle fixation board was used and 'Group 2', which was allocated as the control group using Hypoallergenic Elastic Fixation Tape. PVC life and complications (infiltration, purification, displacement) were recorded.

**RESULTS:** Forty-nine patients were included in the present study and they were divided into the following two groups: 25 patients in Group 1 and 24 patients in Group 2. There were no statistically significant differences between the groups in terms of age and gender ( $p>0.05$ ).

There was no statistically significant difference in PIVC lifespan between Groups 1 (31.8 hours) and 2 (29.5 hours) ( $p = 0.151$ ). The complication rate was noted to be 4% in Group 1 and 29% in Group 2. The difference in complication rates between the two groups was statistically significant ( $p = 0.02$ ).

**CONCLUSIONS:** The rate of complications was lower in pediatric patients with PIVC compared to the other method with the use of a new fixation board (ankle-ankle fixation fixation method). However, no significant results were obtained regarding PIVC life.

**Keywords:** *Peripheral Venous Catheter Fixation Methods, Hypoallergenic Elastic Fixation Tape, Catheter Complications, Catheter Lifespan, Children*

#### ÖZET

**AMAÇ:** Periferik venöz kateterizasyon (PVK) hastaneye yatan çocukların %80'inden fazlasına yapılan invaziv girişimdir. Masum gibi görünen PVK, çocuklarda flebit, enfeksiyon, infiltrasyon, ekstremitasyon gibi çok sayıda komplikasyona, hatta ölüme neden olduğu bilinmektedir. Bu çalışmada, eklem bölgesinde PVK takılı olan pediatrik hastalarda yeni bir fiksasyon tahtasının (bilek-ayak bileği fiksasyon tespit yöntemi) PVK ömrü ve komplikasyon oranlarına etkisini değerlendirmek amaçlandı.

**GEREÇ VE YÖNTEM:** Haziran-Temmuz 2018 tarihleri arasında Çocuk Cerrahisi servisinde tedavi edilen ve eklem bölgesinde PVK takılan 49 hasta ileriye dönük olarak takip edildi. Hastalar 'Grup 1' bilek tespit tahtası kullanılan ve 'Grup 2' hipoalerjenik elastik fiksasyon bandı kullanılan kontrol grubu olarak ikiye ayrıldı. PVC ömrü ve komplikasyonları (infiltrasyon, enfeksiyon, yerinden olma) kaydedildi.

**BULGULAR:** Çalışmaya iki gruba ayrılacak şekilde 49 hasta dâhil edildi. Grup 1'de 25 hasta, Grup 2'de 24 hasta vardı. Gruplar arasında yaş ve cinsiyet açısından istatistiksel olarak anlamlı fark bulunmadı ( $p> 0,05$ ).

PVK ömrü yönünden değerlendirildiğinde Grup 1 (31,8 saat) ve 2 (29,5 saat) arasında fark saptanmadı ( $p = 0,151$ ). Komplikasyon oranı Grup1'de %4, Grup 2'de % 29 olarak bulundu. İki grup arasındaki komplikasyon oran farkı istatistiksel olarak anlamlıydı ( $p = 0,02$ ).

**SONUÇ:** PVK takılan çocuk hastalarda yeni bir fiksasyon tahtasının (bilek-ayak bileği fiksasyon tespit yöntemi) kullanımı ile, diğer yöntemlere göre komplikasyon oranının daha az olduğu saptandı. Fakat PVK ömrü ile ilgili anlamlı bir sonuç elde edilmedi.

**Anahtar Kelimeler:** *Periferik Venöz Kateter Tespit Yöntemleri, Hipoalerjenik Elastik Fiksasyon Bandı, Kateter Komplikasyonları, Kateter Ömrü, Çocuk*

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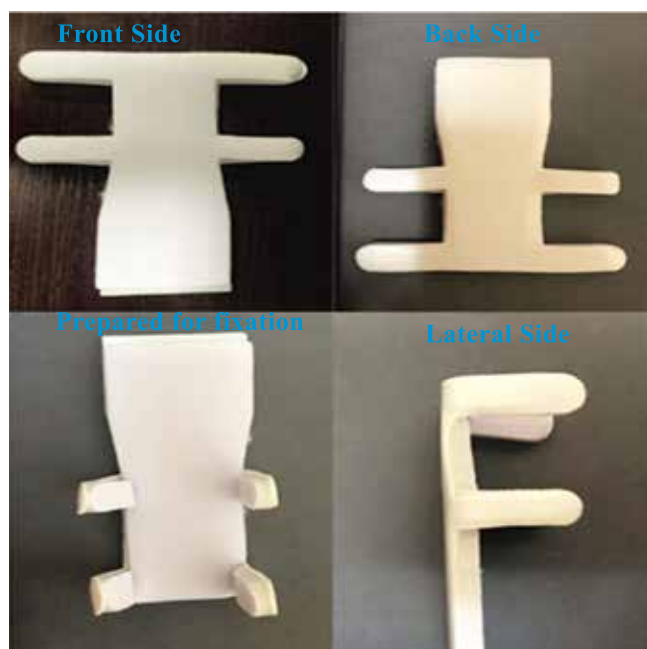
## INTRODUCTION

Peripheral intravenous catheter (PIVC) insertion is the most frequently used invasive intervention that is performed in more than 80% of hospitalized children (1-4). PIVC insertion is indicated in various conditions such as intravenous fluid therapy, continuous or intermittent drug administration, and transfusion of blood and blood products, and it is preferred as the first option since it is less invasive than the insertion of central venous catheter (5-7).

Reportedly, complication rates are higher in loosely bandaged PIVCs (7, 8). PIVC-related complication rates are higher in children than in adult patients (1). A number of invasive and noninvasive methods have been used to prolong catheter lifespan and reduce complications, such as bandaging with Leucoplast, fixing the catheter to the limb using elastic adhesive plaster, splinting, extensive bandaging covering the whole cannula and infusion set, bandaging with a sterile gauze, using Tegaderm and Heparin (4, 9- 12). The dislodgement of PIVCs in a short time and repeated insertion of PIVCs affect costs and morbidity (13). In this study, we aimed to investigate the effect of wrist-ankle fixation board on PIVC lifespan and complications rates in pediatric patients undergoing PIVC insertion in the joint area.

## MATERIAL AND METHOD

A total of 49 patients who were treated in the pediatric surgery ward between June and July 2018 and who underwent PIVC insertion in the joint area (antecubital, wrist, and ankle) were prospectively followed. This study was conducted in accordance with the Helsinki Declaration and has been approved by the ethics committee (28/06/2018/04). Informed consent was obtained from all patients.



**Figure 1. Wrist-ankle fixation board (Unimag-Istanbul/Turkey)**



**Figure 2. Hypoallergenic elastic fixation tape**



**Figure 3. Secured using a limb fixation device**

The patients were divided into the following two groups: 'Group 1' in which a fixation board (Wrist-ankle fixation board/Unimag-Istanbul/Turkey) was used and 'Group 2', which was allocated as the control group using Hypoallergenic Elastic Fixation Tape (Alban-Usak/Turkey). The fixation board is made of a 4-layer material including a cotton fabric surface covering the wrist or ankle, a foam (sponge) sheet for eliminating pressure, an easily shapable aluminum sheet, and a polyethylene (sponge) coating for the smooth appearance of the outer layer (Figure 1).

Patients with comorbidities, those who received total parenteral nutrition, blood, and blood products, and those on polypharmacy were not included in the study, as these cases have been reported to significantly affect PIVC lifespan (12).

Peripheral intravenous catheter insertion and fixation were performed by four nurses with 10–15 years of nursing experience and the PIVC insertion site was checked every 3 hours for the presence of swelling, infiltration, signs of infection, and catheter blockade. The device duration was calculated as the time from the insertion to the removal of PIVC. As previously recommended for all patients, the procedure was performed after the PIVC insertion site was wiped with 70% alcohol and 2% chlorhexidine solution (14). Ultrasonography was not used during

PIVC insertion. The same brand of cannula (Beybi KIT KATH, İstanbul, Turkey) was used for all patients. As performed in routine practice, intravenous line [yellow (24G -19mm) and purple (26G -19 mm) cannula] was randomly dressed either using Hypoallergenic Elastic Fixation Tape (Figure 2) (Group 2) or secured using a limb fixation device (Figure 3) (Group 1). Infusion and medical treatment were provided to all patients with the same set of serum and pump device (Plum A, North Chicago, IL 60064, USA). Infusion time was determined as 30 minute for both groups. The patients' age, cannula gauge, cannula lifespan were recorded. The effects of cannula fixation device, cannula gauge, and age on PIVC lifespan and complication rates (infiltration, infection, dislodgement) were comparatively evaluated between the two groups.

**Statistical Analysis:** All data regarding the patients were reviewed and transferred to the computer environment. The statistical analyses were performed using SPSS 18.0 package program. Three-way analysis of variance was used for data analysis. A p value < 0.05 was considered statistically significant.

**RESULTS**

Forty-nine patients were included in the present study and they were divided into the following two groups: Twenty five patients in Group 1 and 24 patients in Group 2. There were no statistically significant differences between the groups in terms of age and gender (p>0.05). Of these patients, 55% underwent genitourinary surgery and 45% underwent gastrointestinal surgery. Thirty percent of the patients were treated using ampicillin-sulbactam, 50% received ceftriaxone-metronidazole and 20% received ampicillin-sulbactam-amikacin therapy. All data for Groups 1 and 2 including cannula gauge, cannula lifespan, and mean age of the patients are summarized in Table 1.

There was no statistically significant difference in PIVC lifespan between Groups 1 (31.8 hours) and 2 (29.5 hours) (p = 0.151). The analysis of the effects of cannula gauge and age showed p values of 0.142 and 0.081, respectively.

When complications were examined, there was infiltration in one patient in Group 1, and there was infiltration in five patients, mild infection findings (redness and increased temperature) in one patient (It was accepted as grade 1 according to phlebitis scale) (15), and accidental dislodgement caused by fidgeting in one patient in Group 2. The complication rate was

noted to be 4% in Group 1 and 29% in Group 2. The difference in complication rates between the two groups was statistically significant (p = 0.02). Statistical analysis data between the groups is summarized in Table 2.

**Table 2. Statistical analysis data between the groups**

PIVC lifespan	P value		
	Cannula gauge	Age	Complication rate
0.151	0.142	0.81	<b>0.02</b>

**DISCUSSION**

It is often more challenging to supervise children followed in the pediatric wards than adult patients due to their young age and fidgeting. Thus, catheter dislodgement is more likely in these patients. It is a known that seemingly innocent PIVC may result in various morbidities such as phlebitis, infection, infiltration, extravasations, obstruction, clogging, and kinking, and may even lead to mortality (1, 3, 5, 12, 16, 17). Especially, the dislodgement of PIVC in a short time and repeated insertions in children may result in trauma for the patient and their family and the medical staff involved (13). Therefore, PIVC insertion should not be repeated more than necessary.

The adequate securement of the catheter prevents distortion around the catheter and therefore avoids accidental removal, clogging, and catheter infection (8). However, there is no consensus on the most appropriate medical dressing and fixation method at the insertion site, which is the first line of defense against infection (18). Catheter dislodgement and bacterial colonization are the most widely known important complications of PIVC insertion (1, 8, 9). Complications can be influenced by a number of factors including the selection of catheter type, preparation of the site, intermittent or continuous infusion of drugs, administration technique, device duration, dressing type, selected insertion site, appropriate cleaning of PIVC, and adequate fixation (2, 4, 13). Therefore, in the present study, we endeavored to equalize all factors other than the fixation board.

Splinting, which has been used for almost 30 years, reportedly reduces catheter mobility and prolong PIVC lifespan (19, 20). In a book published by the Infusion Nurses Association and in the recommendations of the American Journal of Infection Control group in 2011, adequate fixation reportedly reduced complication rate (7, 8). However, despite the success obtained by the

**Table 1. All data for Groups 1 and 2 including cannula gauge, cannula lifespan, and mean age of the patients**

	Purple PIVC			Yellow PIVC		
	Number of patients	Age (month)	PIVC lifespan (hour)	Number of patients	Age (month)	PIVC lifespan (Hour)
Group 1	15	20.1	33.6	10	28.8	30
Group 2	10	11.7	30.0	14	18.6	29

stabilization of PIVCs, PIVC lifespan remains shorter in children, and complication rates remain higher in newborns (29%–51%) and children (25%) (1, 6, 11-13). Our complication rate in the fixation board group (4%) was much lower than that reported in the literature, whereas it was similar to the literature for the control group (29%) (1, 6, 10-13).

The catheter lifespan was reported to be 23–40 hours in newborns in the intensive care units and 29–60 hours in children (6, 13, 21). The median lifespan of PIVCs was reported to be 1–136 hours and 10–187 hours in other studies, which are similar to our study results (6, 11, 12). In this study, the noninvasive soft-fixation device was believed to secure the catheter in place, prolong cannula lifespan, and reduce complications. Even though there was a significant difference between the groups in terms of complication rate, no significant difference was observed in terms of cannula lifespan.

It has been widely reported that the PIVC insertion site, weight, age, and cannula gauge do not have a significant effect on PIVC lifespan (6, 12, 21). Also, in the present study, age and cannula gauge did not have an effect on PIVC lifespan.

Interestingly, in one study, it was reported that half of the PIVCs were not used within 72 hours (22). Therefore, the necessity of a vascular route should be questioned before establishing a vascular access.

## CONCLUSION

Although the complication rate in this study was significantly reduced, no significant result was obtained regarding PIVC lifespan. Complication rate can be kept low by using a fixation board, providing a strict nursing care, and frequent evaluation of the catheter insertion site. In pediatric practice, PIVC-related complications still persist. Researchers should continue the development of new methods for increasing the lifespan of catheters, especially in children.

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Limitations: Although the use of a fixation board reduced the complication rate, it was considered as a disadvantage that the cost was higher than in the control group. In addition, the nurses who collected the data were volunteers and this study was a part of their job.

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