

EP-206

유리피판 재건술 후 모니터링 체계의 변화: 전공의 기반 감시와 간호사 주도 감시의 비교 분석

(From Resident to Nurse Surveillance in Free Flap Reconstruction: A Comparative Analysis of Monitoring Efficiency and Flap Outcomes)



이화여자대학교 성형외과학교실(이대목동병원)

박진우, 신동렬, 박보영\*

**Purpose:** Early detection and timely re-exploration are critical for successful free flap salvage. With increasing workforce constraints, nurse-led monitoring systems have been introduced, but direct comparisons with resident-based monitoring remain limited. This study aimed to evaluate the impact of monitoring system on workflow efficiency and flap outcomes.

**Methods:** A retrospective cohort analysis was conducted on patients who underwent free flap reconstruction by a single surgeon between 2014 and 2025. From February 2019, a structured nursing-led monitoring protocol replaced resident-based surveillance(Fig. 1).Monitoring characteristics, timing of detection and re-exploration, and flap outcomes were compared between the two groups.

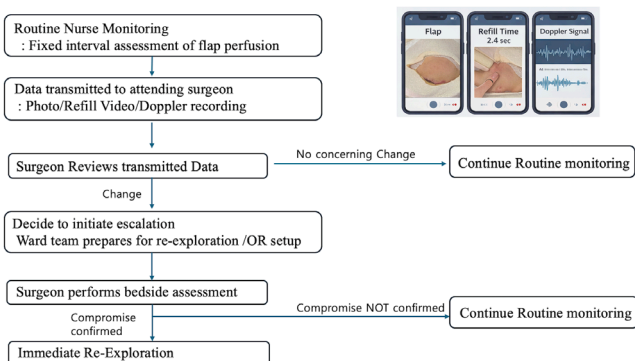


Fig. 1. Monitoring and escalation workflow. Nurses perform structured assessments and transmit data to the attending surgeon. Clinical decisions are made by the surgeon. When vascular compromise is suspected, bedside reassessment and operative preparation proceed simultaneously, enabling timely re-exploration.

**Results:** A total of 499 free flap reconstructions were performed, of which 40 (8.0%) required re-exploration. After excluding incomplete records, 36 cases were analyzed (resident 15, nurse 21). The time from flap operation to detection of vascular compromise was similar between groups. However, the interval from detection to re-exploration was significantly shorter in the nurse group ( $4.2 \pm 3.6$  vs  $7.4 \pm 5.1$  hours,  $p = 0.041$ ). Early revision within 24 hours occurred more frequently in the nurse group (71.4% vs 40.0%,  $p = 0.048$ ). The flap salvage rate was higher in the nurse group (71.4% vs 46.7%), although this did not reach statistical significance ( $p = 0.18$ )(Table. 1.).

Table. 1. Monitoring and Revision Outcomes

| Variable   | Resident(n=15) | Nurse(n=21) | p-value |
|--|----------------|-------------|---------|
| Time from flap operation to compromise detection (h) | 28.6 ± 16.8    | 25.9 ± 12.4 | 0.54    |
| Time from detection to re-exploration (h)            | 7.4 ± 5.1      | 4.2 ± 3.6   | 0.041 * |
| Total time (flap operation to re-exploration(h))     | 36.0 ± 17.9    | 30.1 ± 13.4 | 0.27    |
| Cause of re-exploration, n (%)                       |                |             | 0.61    |
| Arterial   | 10 (66.7 %)    | 12 (57.1 %) |         |
| Venous   | 2 (13.3 %)     | 2 (9.5 %)   |         |
| Mixed  | 3 (20.0 %)     | 7 (33.3 %)  |         |
| Revision within 24 h, n (%)                          | 6 (40.0%)      | 15 (71.4 %) | 0.048*  |
| Flap salvaged after re-exploration, n (%)            | 7 (46.7 %)     | 15 (71.4 %) | 0.18    |
| Partial necrosis or total loss, n (%)                | 8 (53.3%)      | 6 (28.6 %)  | -       |

Continuous data = mean ± SD; categorical data = number (%) using Fisher's exact or t-test as appropriate. \*  $p < 0.05$  considered statistically significant.

In univariable analysis, early revision (<24 hours) was significantly associated with flap salvage (OR 3.45,  $p = 0.036$ ). In multivariable analysis, both nurse-led monitoring (OR 3.24,  $p = 0.046$ ) and early revision (<24 hours) (OR 3.01,  $p = 0.047$ ) were independently associated with improved flap salvage (Table 2).

Table. 2. Univariate and Multivariable analysis for predictors of flap salvage

| Variable                  | Univariable analysis |         | Multivariable analysis |         |
|---------------------------|----------------------|---------|------------------------|---------|
|                           | OR                   | p-value | OR                     | p-value |
| Revision <24 hrs          | 3.45 (1.02 – 11.65)  | 0.036 * | 3.01 (0.96 – 9.43)     | 0.047*  |
| Group(Nurse vs Resident)  | 2.89 (0.82 – 10.15)  | 0.097   | 3.24 (1.02 – 10.27)    | 0.046*  |
| Cause( Mixed vs Arterial) | 1.64 (0.41 – 6.50)   | 0.49    | 1.38 (0.32 – 5.89)     | 0.66    |
| Cause(Venous vs Arterial) | 0.92 (0.12 – 6.70)   | 0.94    |                        |         |
| PAOD                      | 0.61 (0.13 – 2.94)   | 0.54    | 0.69 (0.12 – 3.78)     | 0.67    |
| Diabetes mellitus         | 0.89 (0.21 – 3.75)   | 0.87    |                        |         |
| Hypertension              | 0.74 (0.18 – 3.10)   | 0.68    |                        |         |
| Age                       | 0.91 (0.63 – 1.31)   | 0.60    |                        |         |
| Flap size                 | 0.98 (0.93 – 1.03)   | 0.43    |                        |         |

(PAOD = Peripheral Arterial Occlusive Disease)

Mediation analysis demonstrated that earlier revision partially mediated the effect of nurse-led monitoring on flap salvage, accounting for approximately 52% of the total effect.

**Conclusion:** Structured nurse-led monitoring was associated with efficient detection and earlier re-exploration following vascular compromise. The results show that optimization of monitoring workflow may contribute to improved clinical outcomes and support a protocol-driven, team-based approach to postoperative flap surveillance.