

# Impact of Negative Pressure Wound Therapy with Instillation (NPWTi-d) on Outcomes in Prosthetic Joint Infections: A Retrospective Cohort Study



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## Introduction

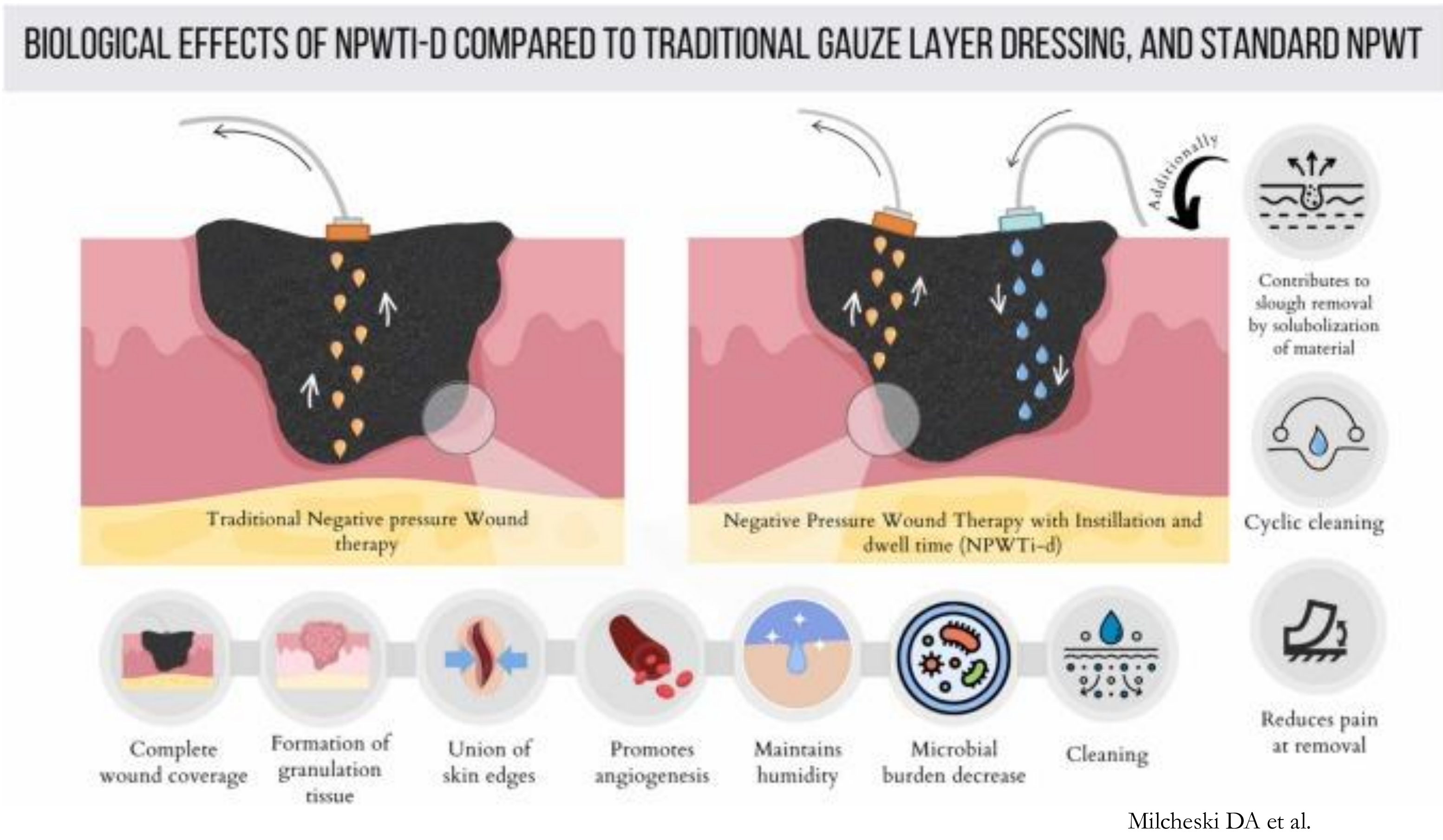
- Periprosthetic joint infection (PJI) is a severe complication of joint arthroplasty often requiring multiple surgeries and prolonged antibiotics.
- Negative pressure wound therapy with instillation (NPWTi-d) combines wound irrigation and negative pressure to reduce bacteria, improve perfusion, and decrease dead space.
- Two-stage revision remains the gold standard for complex PJIs, but success rates are variable with frequent recurrence.
- NPWTi-d may improve wound preparation and biofilm disruption before reimplantation, though its benefit in PJIs is not yet fully proven.
- This study evaluated the impact of NPWTi-d on treatment outcomes and complications in patients with periprosthetic joint infection (PJI), hypothesizing that its use may influence complication and success rates.

## Methods

- A retrospective review of 111 adults with culture-confirmed periprosthetic joint infections (PJIs) from 2015–2025 was performed.
- 37 patients treated with NPWTi-d therapy were matched 2:1 with 74 controls based on demographic and clinical factors. Outcomes included infection eradication without recurrence or reoperation, as well as complication rates. Logistic and negative binomial regression analyses were used to evaluate factors associated with treatment outcomes.

## Results

- Gender distribution, smoking status, type of surgery, polymicrobial status, CCI, age, and BMI did not differ significantly between groups ( $p \geq 0.28$ ). Table 1
- Patients treated with NPWTi-d underwent a higher number of total surgeries (median 4 vs. 2,  $p < 0.001$ ) and received a greater number of antibiotic doses within the spacer (median 3 vs. 1,  $p = 0.02$ ). Table 1
- Explantation was less frequent in the NPWTi-d group compared to the non-NPWTi-d group (8.1% vs. 24.3%,  $p = 0.04$ ). Table 1



| Table 2. Logistic Regression Analysis of Factors Associated with Treatment Success |           |            |                |              |                |
|------------------------------------------------------------------------------------|-----------|------------|----------------|--------------|----------------|
| Variable                                                                           | Category  | Odds Ratio | Standard Error | P            | 95% CI         |
| Ever Explanted                                                                     | No        | Reference  |                |              |                |
|                                                                                    | Yes       | 0.19       | 0.22           | 0.156        | 0.02 – 1.89    |
| Pathogen Category                                                                  | Bacterial | Reference  |                |              |                |
|                                                                                    | Negative  | 1.11       | 1.47           | 0.935        | 0.08 – 14.90   |
|                                                                                    | Fungal    | 0.31       | 0.16           | <b>0.028</b> | 0.11 – 0.88    |
| Smoking                                                                            | Current   | Reference  |                |              |                |
|                                                                                    | Former    | 8.12       | 5.76           | <b>0.003</b> | 2.02 – 32.60   |
|                                                                                    | Never     | 4.18       | 2.86           | <b>0.036</b> | 1.09 – 15.99   |
|                                                                                    |           | 0.58       | 0.16           | 0.054        | 0.33 – 1.01    |
| Total Number of Spacers                                                            |           | 0.7        | 0.11           | <b>0.027</b> | 0.51 – 0.96    |
| CCI Score (0–37)                                                                   |           | 1.0008     | 0.0007         | 0.285        | 0.9994 – 1.002 |
| P values below 0.05 are bold.                                                      |           |            |                |              |                |

- Fungal infections were significantly associated with lower odds of treatment success compared with bacterial infections (OR [Odds Ratio] 0.31, 95% CI [Confidence Interval] 0.11–0.88,  $p = 0.028$ ).
- Smoking status also demonstrated a strong association: former smokers (OR 8.12, 95% CI 2.02–32.60,  $p = 0.003$ ) and never smokers (OR 4.18, 95% CI 1.09–15.99,  $p = 0.036$ ) had markedly higher odds of success compared with current smokers.
- Higher CCI scores were negatively associated with treatment success (OR 0.70, 95% CI 0.51–0.96,  $p = 0.027$ ).
- A trend toward reduced odds of success was also observed with an increasing number of spacers (OR 0.58, 95% CI 0.33–1.01,  $p = 0.054$ ).
- Use of antibiotics in cement was independently associated with an increased number of complications (coefficient 1.35, 95% CI 0.91–1.80,  $p < 0.001$ ) demonstrated by negative binomial regression analysis of complications
- Both higher total number of surgeries (coefficient 0.10, 95% CI 0.02–0.17,  $p = 0.014$ ) and higher CCI score (coefficient 0.17, 95% CI 0.05–0.28,  $p = 0.003$ ) were also significant predictors of increased complications
- Within the failure group ( $n = 50$ ), the association between NPWTi-d treatment and complications was further evaluated (Table 4). Rates of chronic antibiotic suppression and chronic spacer use did not differ significantly between patients treated with NPWTi-d) and those without (chronic suppression: 14% vs. 10%,  $p = 0.67$ ; chronic spacer: 10% vs. 10%,  $p = 0.92$ ).

| Table 1. Comparison of Patient Characteristics Between NPWTi-d and Non-NPWTi-d Groups |           |                    |                    |                    |                  |
|---------------------------------------------------------------------------------------|-----------|--------------------|--------------------|--------------------|------------------|
|                                                                                       |           |                    |                    |                    |                  |
| Variable                                                                              | Category  | Totals             | No NPWTi-d         | NPWTi-d            | P                |
| Gender                                                                                | Female    | 56 (50.45%)        | 35 (47.3%)         | 21 (56.8%)         | 0.35             |
|                                                                                       | Male      | 55 (49.55%)        | 39 (52.7%)         | 16 (43.2%)         |                  |
| Ever Explanted                                                                        | No        | 21 (18.92%)        | 56 (75.7%)         | 34 (91.9%)         | <b>0.04</b>      |
|                                                                                       | Yes       | 90 (81.08%)        | 18 (24.3%)         | 3 (8.1%)           |                  |
| Pathogen Category                                                                     | Negative  | 9 (8.11%)          | 37 (50.0%)         | 20 (54.1%)         | 0.75             |
|                                                                                       | Bacterial | 57 (51.35%)        | 7 (9.5%)           | 2 (5.4%)           |                  |
|                                                                                       | Fungal    | 45 (40.54%)        | 30 (40.5%)         | 15 (40.5%)         |                  |
| Antibiotics in Cement                                                                 | No        | 94 (86.24%)        | 62 (84.9%)         | 32 (88.9%)         | 0.57             |
|                                                                                       | Yes       | 15 (13.76%)        | 11 (15.1%)         | 4 (11.1%)          |                  |
| Smoking Status                                                                        | Current   | 23 (20.72%)        | 15 (20.3%)         | 8 (21.6%)          | 0.28             |
|                                                                                       | Former    | 44 (39.64%)        | 33 (44.6%)         | 11 (29.7%)         |                  |
|                                                                                       | Never     | 44 (39.64%)        | 26 (35.1%)         | 18 (48.6%)         |                  |
| Type of Surgery                                                                       | THA       | 48 (43.24%)        | 31 (41.9%)         | 17 (45.9%)         | 0.68             |
|                                                                                       | TKA       | 63 (56.76%)        | 43 (58.1%)         | 20 (54.1%)         |                  |
| Polymicrobial status                                                                  | No        | 54 (48.65%)        | 38 (51.4%)         | 16 (43.2%)         | 0.42             |
|                                                                                       | Yes       | 57 (51.35%)        | 36 (48.7%)         | 21 (56.8%)         |                  |
|                                                                                       |           | 59 (51 – 66)       | 58.5 (50 – 67)     | 59 (51 – 66)       | 0.96             |
| BMI                                                                                   |           | 34.8 (29.4 – 40.3) | 34.9 (30.2 – 40.3) | 33.9 (27.8 – 41.1) | 0.52             |
| Total Number of Surgeries                                                             |           | 3 (2 – 4)          | 2 (1 – 3)          | 4 (3 – 5)          | <b>&lt;0.001</b> |
| Total Spacers                                                                         |           | 1 (0 – 2)          | 1 (0 – 2)          | 1 (0 – 2)          | 0.10             |
| CCI Score                                                                             |           | 1 (1 – 3)          | 1.5 (0 – 3)        | 1 (1 – 3)          | 0.73             |
| Doses of Antibiotics in Spacer                                                        |           | 2 (0 – 3)          | 1 (0 – 3)          | 3 (0 – 4)          | <b>0.02</b>      |
| Interval to PJI (days)                                                                |           | 776 (78 – 2268)    | 962 (78 – 2744)    | 430 (80 – 2027)    | 0.48             |
| Last Follow-up from last surgery (days)                                               |           | 1 (0 – 1)          | 225 (122 – 591)    | 376 (159 – 556)    | 0.50             |

| Table 4. Association Between NPWTi-d Treatment and Complications (Failure Group Only, n = 50) |     |            |             |      |
|-----------------------------------------------------------------------------------------------|-----|------------|-------------|------|
| Complication                                                                                  |     | NPWTi-d No | NPWTi-d Yes | P    |
| Chronic Suppression                                                                           | No  | 26 (90%)   | 18 (86%)    | 0.67 |
|                                                                                               | Yes | 3 (10%)    | 3 (14%)     |      |
| Chronic Spacer                                                                                | No  | 26 (90%)   | 19 (90%)    | 0.92 |
|                                                                                               | Yes | 3 (10%)    | 2 (10%)     |      |

## Conclusion

- NPWTi-d therapy was associated with reduced explantation rates in PJI patients, even though it was often employed in cases with greater surgical complexity.
- Infection type, smoking status, and comorbidity burden were the strongest determinants of treatment outcomes.
- While NPWTi-d may serve as an important adjunctive tool in select patients, comprehensive patient optimization and tailored infection management remain the cornerstones of PJI care.

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