

# Serial Assessment of HeartMate 3 Pump Position and Inflow Angle and Effects on Adverse Events

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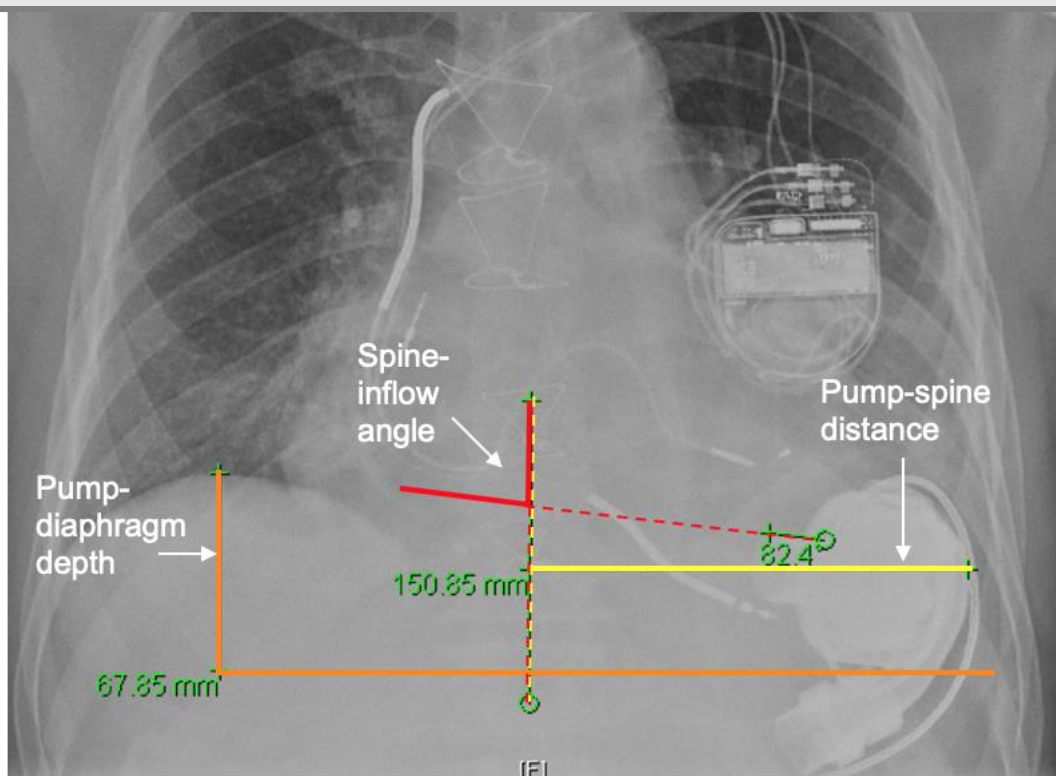
## OBJECTIVES

More than 50% of patients who receive continuous flow LVADs are hospitalized in the first six months following implantation, increasing to 80% within one year.<sup>1</sup> The HeartMate 3 matched the 1-year survival rate of heart transplants and improved survival free of major adverse events as compared to the HeartMate II.<sup>2,3</sup> This study assessed whether the HeartMate 3 exhibits the same tendency to change position following implantation as the HeartMate II and investigated whether pump position or movement is associated with adverse events related to pump malfunction.

## METHODS

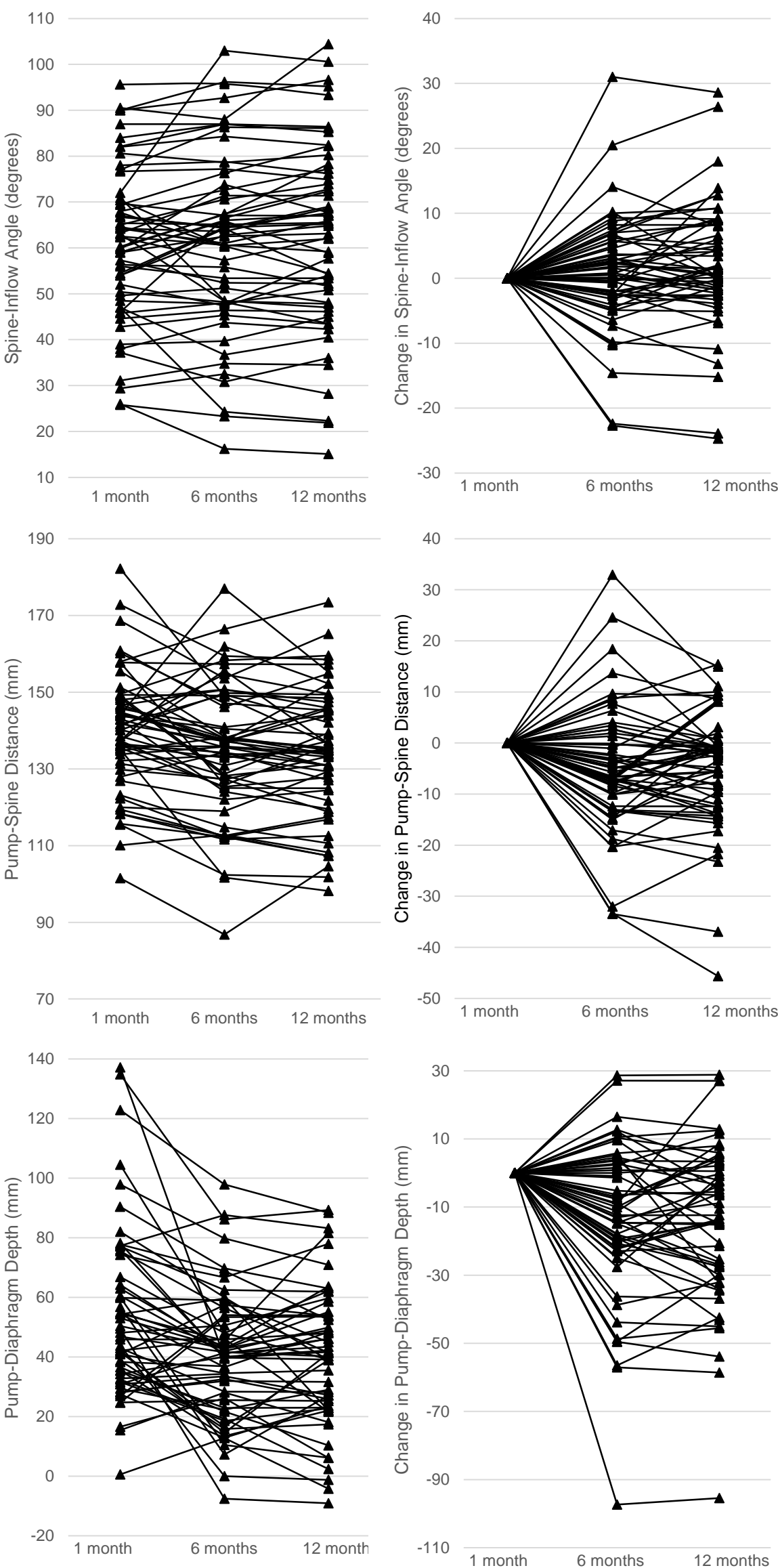
We retrospectively analyzed 59 LVAD recipients who had serial chest radiographs at 1, 6, and 12 months post-implantation between November 2014 and June 2018. We measured pump angle, pump-spine distance, and pump-diaphragm depth and investigated their relationship to a composite outcome of heart failure readmission, low flow alarms, stroke, or inflow/outflow occlusion requiring surgical repositioning through recurrent event survival modeling.

### LVAD Measurements



## RESULTS

Fifty-nine patients were included in this study. During the median follow-up of 2.06 years, 26 (44%) were readmitted to the hospital for position-related adverse events. Patients who had position-related adverse events were more likely to be female ( $p=0.02$ ) and had lower preoperative hematocrit level.



Both pump-spine distance and pump-diaphragm depth changed significantly from 1 to 6 months post-implantation ( $9.99 \pm 8.36$  mm,  $p=0.002$  and  $18.80 \pm 17.71$  mm,  $p<0.001$ , respectively).

Only the initial spine-inflow angle was significantly associated with position-related adverse events ( $p=0.04$ ). Patients who had position-related readmissions had a median 1-month spine-inflow angle of 66.2 degrees (IQR 54.5-78.0), while patients without later position-related readmissions had a median spine-inflow angle of 59.0 degrees (IQR 47.0-65.0).

Pump-diaphragm depth change over time was weakly associated with position-related readmissions (Hazard ratio = 1.020, 95% CI = 1.000-1.040 for movement between 1 to 6 months post-implantation; Hazard ratio = 1.019, 95% CI = 1.000-1.039 for movement between 6 to 12 months post-implantation).

## CONCLUSIONS

We found that the initial pump angle is associated with adverse clinical outcomes, that the pump moves both vertically and horizontally following implantation, and that pump movement may affect subsequent adverse events. Consideration of pump position at implantation and careful monitoring of pump position in follow-up imaging may provide an avenue to further improve patient outcomes with the HeartMate 3.

## REFERENCES

1. The Society of Thoracic Surgeons Intermacs database annual report: Evolving indications, outcomes, and scientific partnerships, *Journal of Heart and Lung Transplantation*
2. The Society of Thoracic Surgeons Intermacs 2019 annual report: The changing landscape of devices and indications, *Annals of Thoracic Surgery*
3. A fully magnetically levitated circulatory pump for advanced heart failure, *New England Journal of Medicine*