



Limb Lengthening Following Internal Hemipelvectomy

Alan Slipak, Justin E Bird, Bryan S Moon, Robert L Satcher, Patrick P Lin, Spencer J Frink, Valerae O Lewis

Introduction

While internal hemipelvectomy patients can obtain in excellent function, the procedure often results in a significant limb length discrepancy (LLD). Shoe lifts are worn to compensate for the limb length discrepancy. Psychosocial factors also play a role in the use of a shoe lift for LLD, particularly in a young population.

Recently magnetically powered telescoping intramedullary implants have been developed that facilitate for minimal invasive limb lengthening. Our study sought to answer the following questions: (1) Can magnetically powered telescoping intramedullary nail correct the LLD that results after internal hemipelvectomy without reconstruction. 2) Does lengthening of the affected side results in a improved gait/functional outcome.

Methods

After obtaining IRB approval patients who had undergone internal hemipelvectomy without reconstruction and were identified as candidates for leg lengthening. The Precise retrograde femoral nails were inserted based on the approved technique. Osteotomy was created in metaphyseal bone at the distal femur. Lengthening was then performed using the Nuvasive system. After radiographic union, all devices were removed. Patient demographics and function were recorded both prior to and after leg lengthening.

	Age	Resection Type	Preop LLD (mm)	Final LLD (mm)	Radiographic Time to Union (months)
1	12	II	80	0	4
2	18	II	25	10	4
3	21	II	55	0	4
4	16	II	45	0	3
5	41	I	25	0	3
6	21	II	65	0	4

Table 1. Patient demographic and limb length discrepancy data.

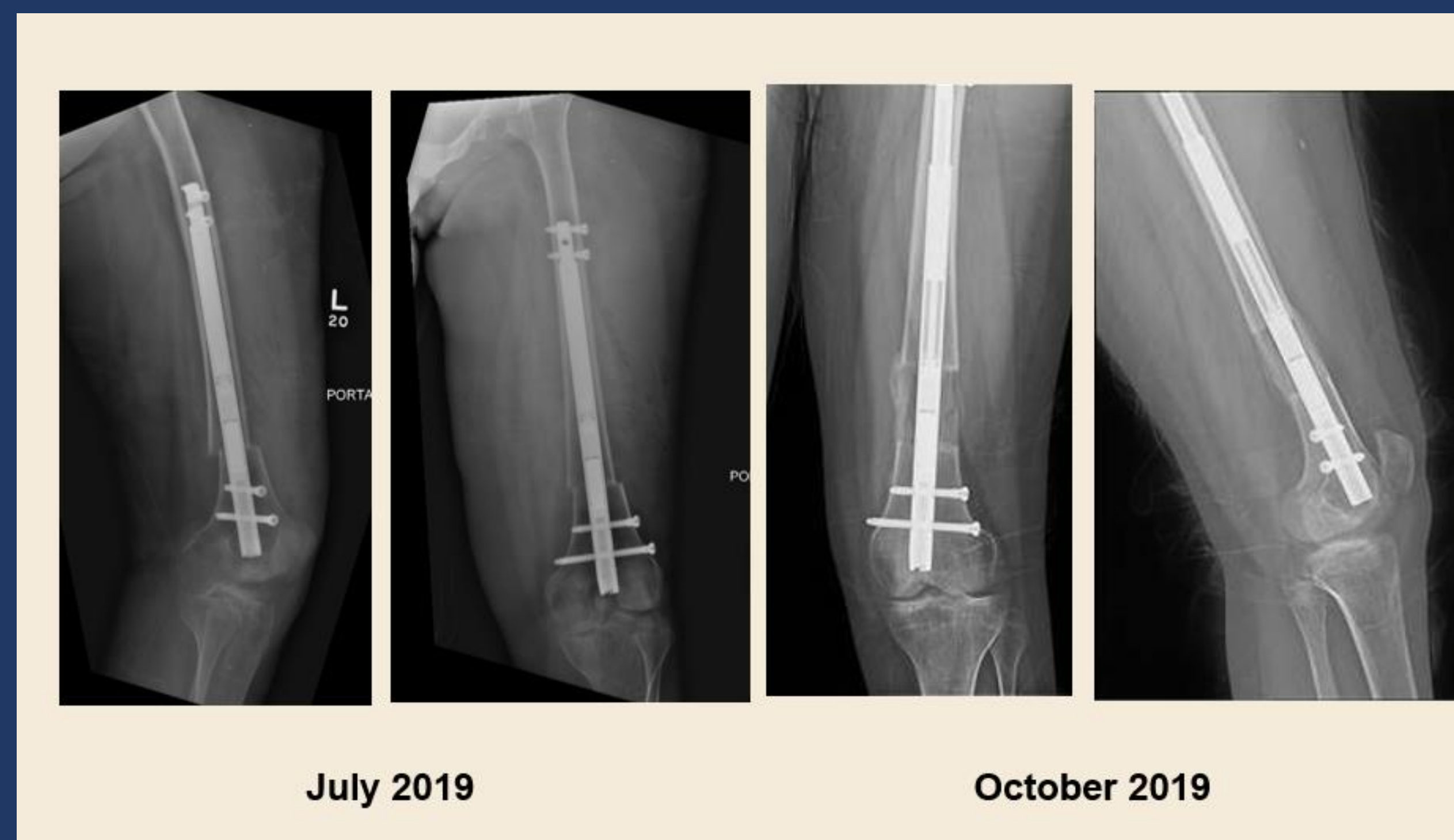


Figure 1. Radiographic images demonstrating initial postoperative and regenerate healing after lengthening.



Figure 2. Clinical photo of patient sitting after lengthening procedure.

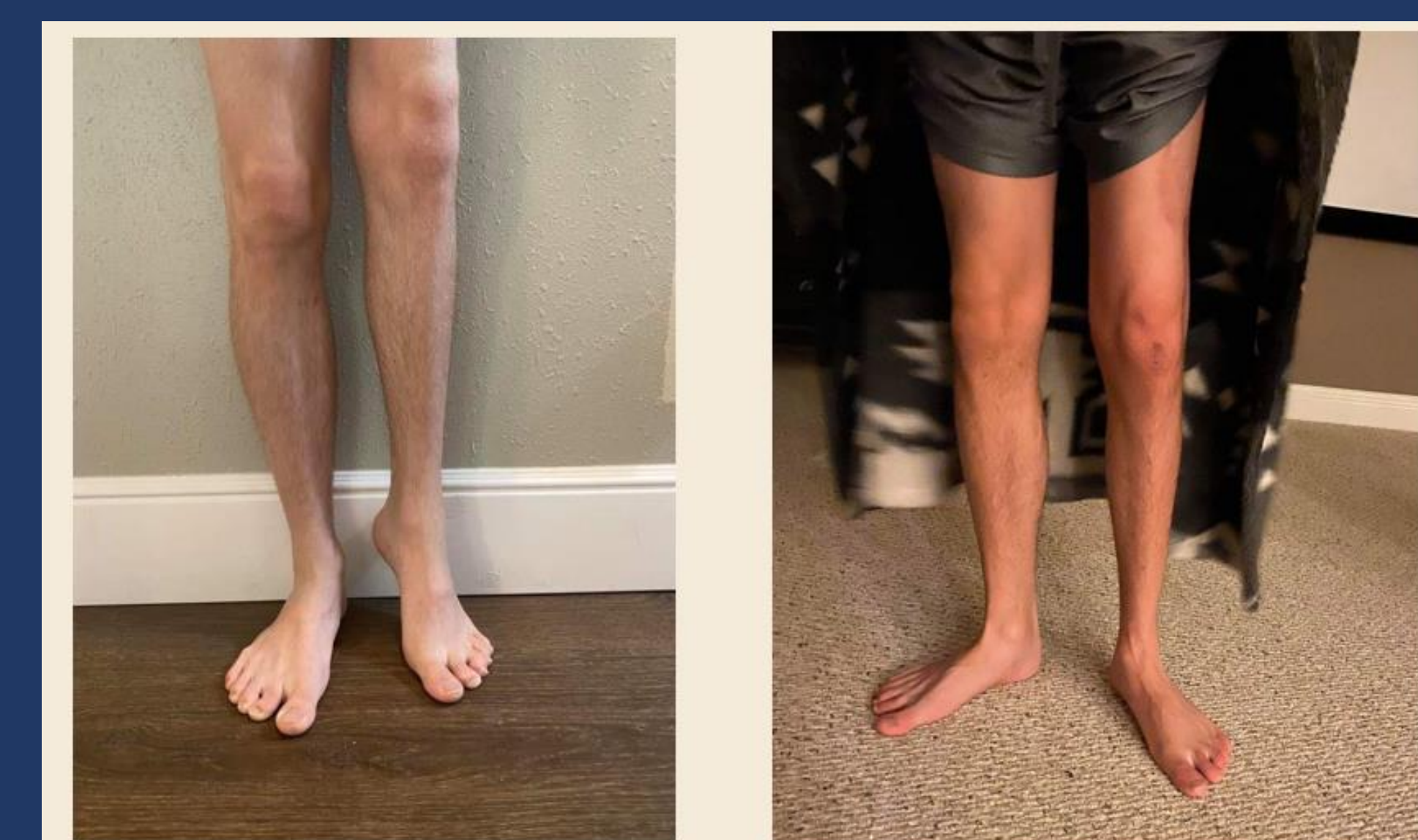
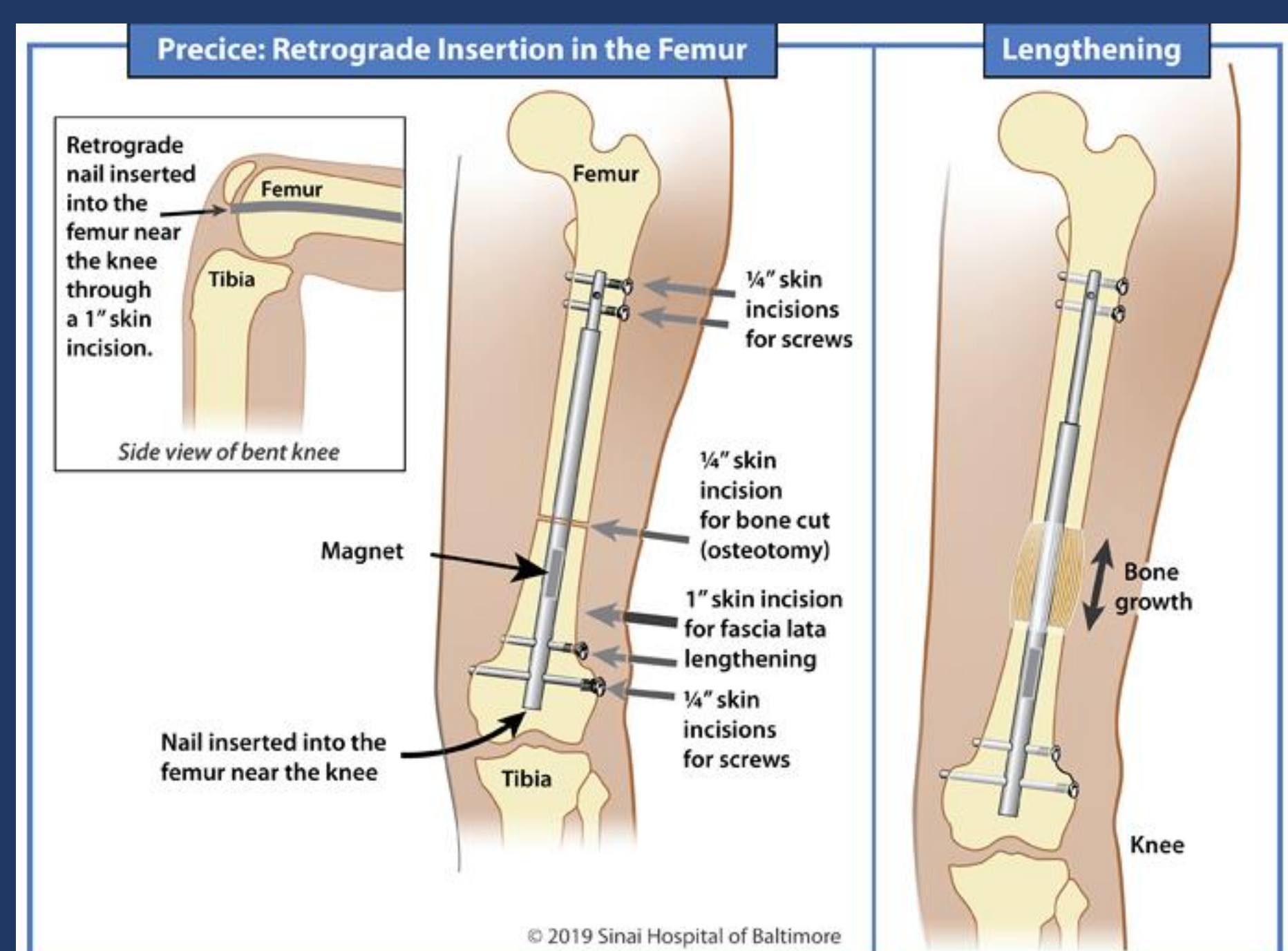


Figure 3. Clinical photo of patient before and after leg lengthening procedure.



Results

The six patients who underwent Precise intramedullary nail placement were identified. One patient required two lengthening procedures due to small size of nail at initial surgery. Five of the patients underwent Type 2 hemipelvectomies and were left flail resulting in a limb length discrepancy. One patient underwent a Type 1 internal hemipelvectomy with free fibula reconstruction. He suffered a nonunion and shortening resulting in a limb length discrepancy. Average age of our patients was 21.5 years (range 12-41). Average preoperative LLD was 47.9 mm, (range 25-80). All patients in our cohort went on to radiographic union without additional procedures. After healing, all patients had their intramedullary lengthening devices removed. There were no complications related to surgery or the lengthening process. At final follow-up there was no perceivable limb length discrepancy and all patients ambulated independently without gait aids or shoe lifts.

Discussion

Flail limbs after internal hemipelvectomy have both cosmetic and functional consequences. They avoid the high complication rates associated with prostheses or allograft reconstructions of the pelvis. Our series demonstrates a minimally invasive technique to achieve equal limb lengths. This led to an improved gait, discontinuation of shoe lifts and improved body image in our cohort of patients. Further investigation comparing the outcomes of these patients to other hemipelvectomy reconstructive options is warranted at this time. Historically

References

- Enneking, W. F. (1990). A system for the classification of skeletal resections. *Chir. Org. Mov.*, 75(1), 217-240.
- Kollender, Y., Shabat, S., Bickels, J., Flusser, G., Isakov, J., Neuman, Y., ... & Meller, I. (2000). Internal hemipelvectomy for bone sarcomas in children and young adults: surgical considerations. *European Journal of Surgical Oncology (EJSO)*, 26(4), 398-404.
- Wang, J., Min, L., Lu, M., Zhang, Y., Wang, Y., Luo, Y., ... & Tu, C. (2020). What are the Complications of Three-dimensional-printed Custom-made Integrative Hemipelvic Endoprostheses in Patients with Primary Malignancies Involving the Acetabulum, and What is the Function of These Patients?. *Clinical Orthopaedics and Related Research*.
- Griesser, M. J., Gillette, B., Crist, M., Pan, X., Muscarella, P., Scharshmidt, T., & Mayerson, J. (2012). Internal and external hemipelvectomy or flail hip in patients with sarcomas: quality-of-life and functional outcomes. *American journal of physical medicine & rehabilitation*, 91(1), 24-32.
- Gordon, J. E., & Davis, L. E. (2019). Leg length discrepancy: the natural history (and what do we really know). *Journal of Pediatric Orthopaedics*, 39, S10-S13.
- Khamis, S., & Carmeli, E. (2017). Relationship and significance of gait deviations associated with limb length discrepancy: A systematic review. *Gait & Posture*, 57, 115-123.
- Khamis, S., & Carmeli, E. (2017). Relationship and significance of gait deviations associated with limb length discrepancy: A systematic review. *Gait & Posture*, 57, 115-123.
- Barinaga, G., Beason, A. M., & Gardner, M. P. (2018). Novel surgical approach to segmental bone transport using a magnetic intramedullary limb lengthening system. *The Journal of the American Academy of Orthopaedic Surgeons*, 26(22), e477.
- Wagner, P., Burghardt, R. D., Green, S. A., Specht, S. C., Standard, S. C., & Herzenberg, J. E. (2017). PRECICE® magnetically-driven, telescopic, intramedullary lengthening nail: pre-clinical testing and first 30 patients. *Sicot-j*, 3.
- Kirane, Y. M., Fragomen, A. T., & Rozbruch, S. R. (2014). Precision of the PRECICE® internal bone lengthening nail. *Clinical Orthopaedics and Related Research*, 472(12), 3869-3878.