

## INTRODUCTION

- Metaphyseal malunions and nonunions of the lower extremity pose a challenge in the setting of complex, multiplanar deformity and poor bone quality
- Optimal treatment corrects all parameters of deformity and provides stable fixation for early weight bearing and rehabilitation
- Current options for correction include single and double cut osteotomies stabilized with plate fixation, or gradual correction with fine wire circular fixation
- Both classic osteotomies and fine wire circular frames have significant limitations
- The clamshell osteotomy was developed to simplify the correction of tibial and femoral diaphyseal malunions and nonunions, but had not been studied for use in metaphyseal and meta-diaphyseal deformities

## OBJECTIVES

- Is the clamshell osteotomy a valid option for treating complex metaphyseal and meta-diaphyseal deformities?
- What are the union rates and complications from metaphyseal and meta-diaphyseal clamshell osteotomies?

## METHODS

- Retrospective chart review from January 2010 – December 2018
- Inclusion criteria:
- Metaphyseal and meta-diaphyseal deformity of tibia or femur
  - Clamshell osteotomy performed at UCD
  - Age > 18 years old
- Exclusion criteria:
- Follow up < 4 months
- 16 patients met inclusion and exclusion criteria
  - Radiographic union assessed using modified RUST (mRUST) score

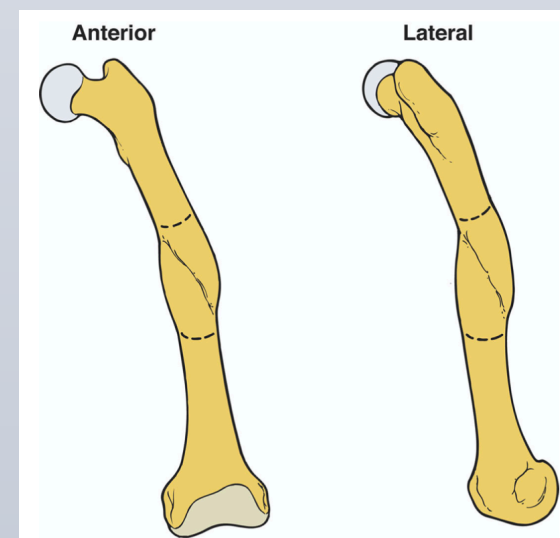


Figure 1. Depiction of malunion to be corrected

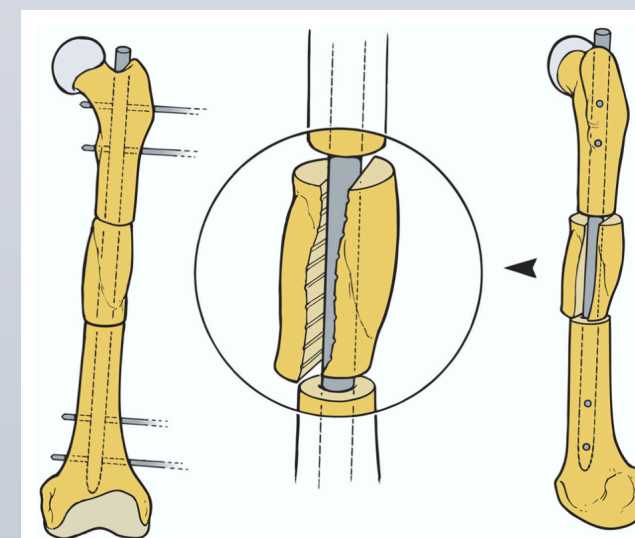


Figure 2. Osteotomized clamshell segment with IMN

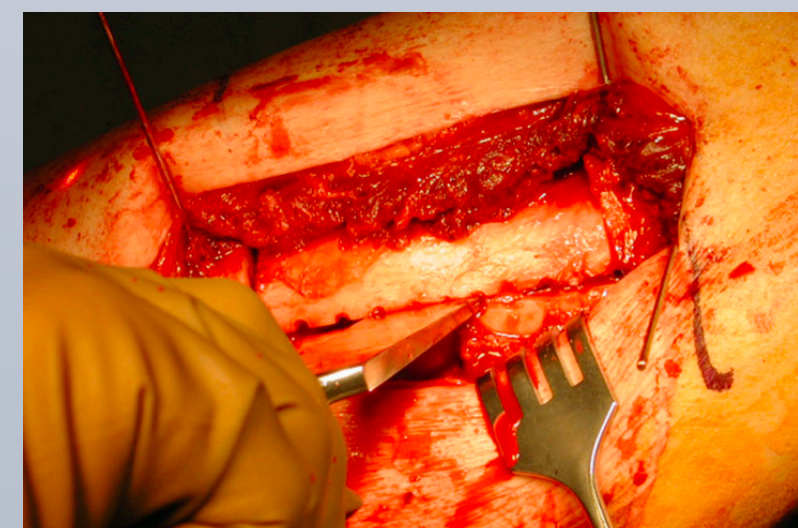


Figure 3. Once the deformed segment is transected, the osteotomized segment is wedged open like a clamshell

## RESULTS

- 13/16 (81.25%) patients achieved radiographic union\* (range 3-27 months, average 10 months)
  - 11/16 (68.75%) patients achieved union after initial procedure (range 3-13 months, average 8 months)
- 4/16 (25%) patients required revision surgery
  - 2/4 patients went on to union
- 7 patients had wound issues, 3 requiring surgical debridement
- 2 patients had a pulmonary embolus, 1 had a GI bleed

Patient ID	Varus	Valgus	Flexion	Extension	Reason	Location	Mos. to Union
1	15		21		Mal	Femur	8
2		12		5	Non	Femur	12
3	16			12	Mal	Tibia	11
5	61		31		Mal	Tibia	27**
6		16		15	Mal	Tibia	13
7		15	20		Mal	Tibia	10**
8	31		40		Non	Tibia	***
9	14			8	Non	Femur	7
10		13		19	Non	Tibia	11
11		14		40	Mal	Tibia	**
12	12				Non	Tibia	**
13		22	10		Mal	Tibia	10
14		33		6	Non	Tibia	8
15		12			Mal	Tibia	4
17		36	8		Mal	Tibia	3
18		15	13		Genetic	Tibia	5

Table 1. Summary of preoperative deformity, indication for procedure and time (months) to union

\*Union defined as mRUST score  $\geq$  12

\*\* Underwent second procedure (exchange IMN)

\*\*\* Declined second procedure, lost to follow up prior to union

## CONCLUSIONS

- Clamshell osteotomy is a valid option for treating complex metaphyseal and meta-diaphyseal deformities
- An acceptable union rate can be seen using modern nail designs and atraumatic technique
- Advantages include early weight bearing, acute correction, and use of local bone graft
- Union times can be long, complications are not uncommon, and some patients will require secondary procedures

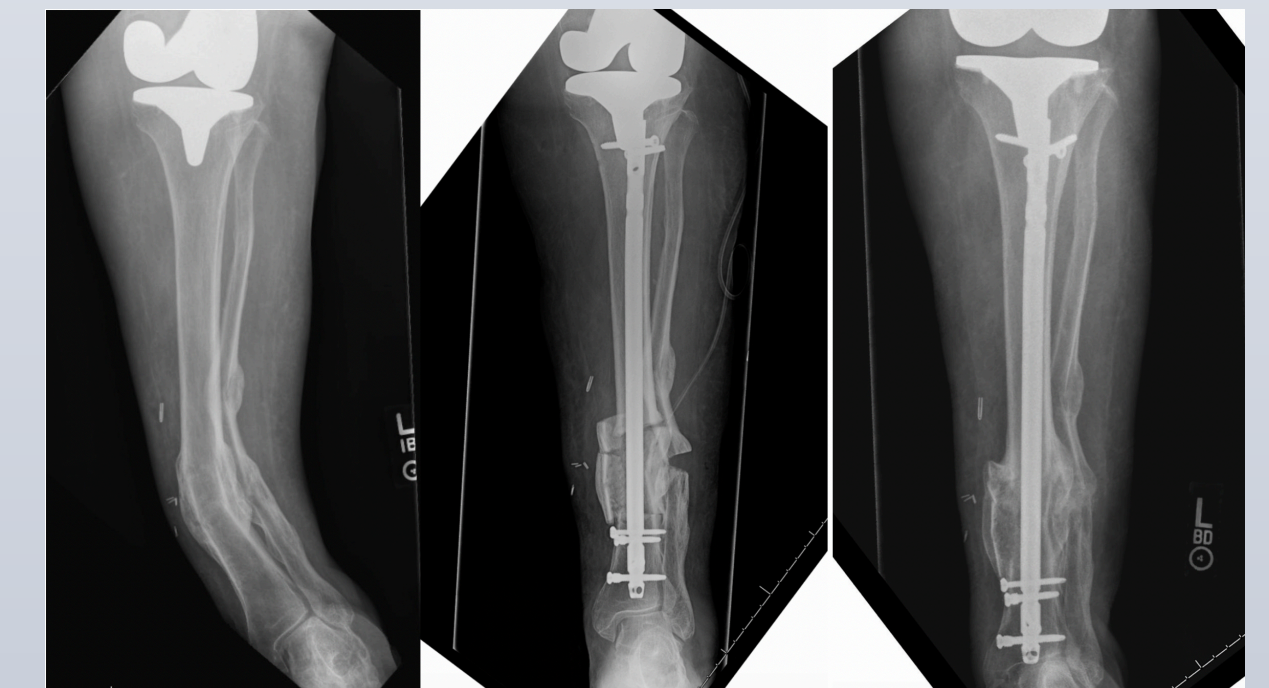


Figure 4. Preoperative (left), immediately postoperative (center) and healed (right) radiographs

## REFERENCES

- Russell, et al. The clamshell osteotomy: a new technique to correct complex diaphyseal malunions. J Bone Joint Surg Am. 2009;91:314–324.
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