



# Biomechanical Comparison of Nitinol Compression Staples versus Fully Threaded Lag Screws for Talonavicular Fusion

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## Introduction

- Arthrodesis of the talonavicular joint is indicated for injury- and arthritis-related pain and is associated with consistently favorable outcomes. Current techniques for talonavicular arthrodesis vary, however, lag screw fixation is considered the reference standard.
- While nitinol compression staples have purported advantages for talonavicular arthrodesis, there is a relative paucity of data regarding their biomechanical performance compared to screw fixation.
- This study was designed to compare nitinol compression staples to fully threaded lag screws for use in talonavicular arthrodesis with respect to their biomechanical properties during functional testing.

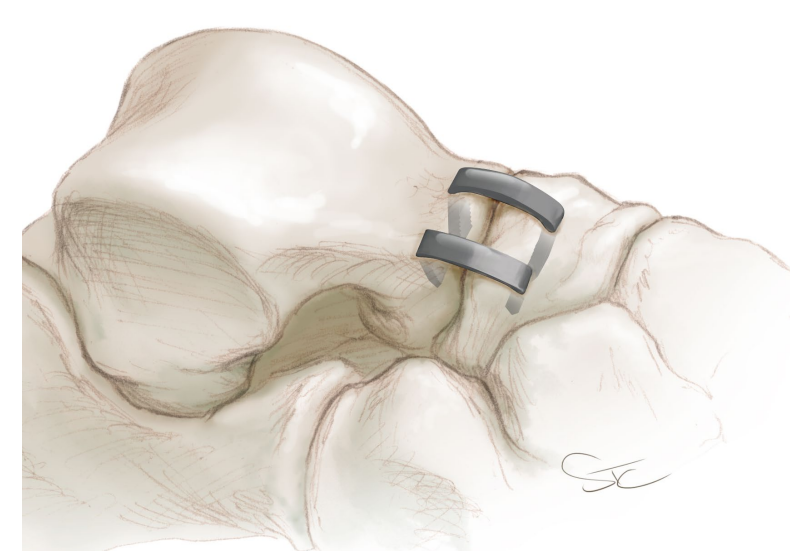
## Null Hypothesis

Nitinol compression staples will not be significantly different from fully threaded lag screws based on clinically relevant biomechanical properties measured during functional robotic testing of the hindfoot.

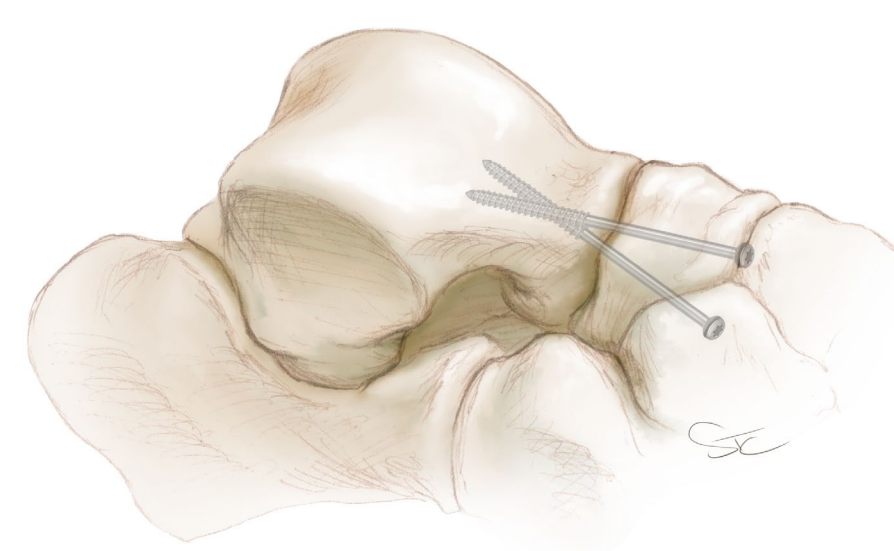
## Methods



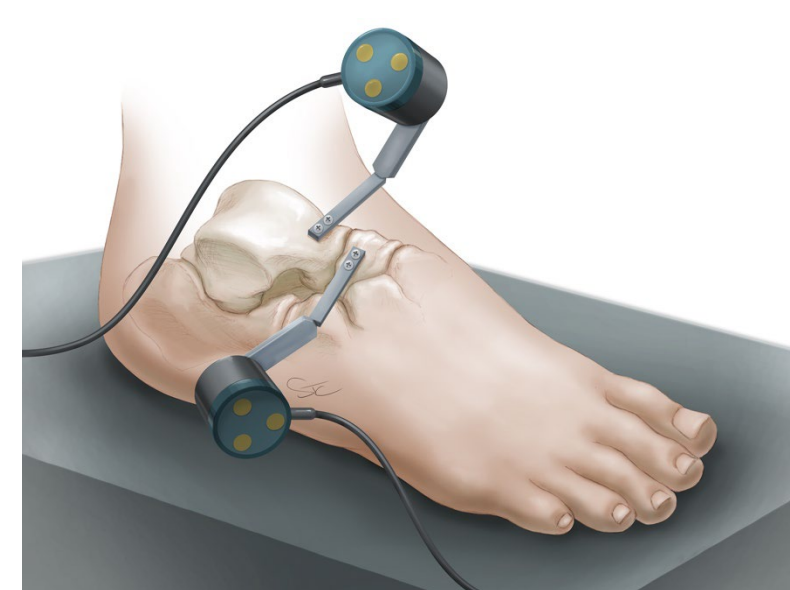
Donor foot & ankle specimens (n=12; 6 matched pairs: 2F, 4M, mean age 79.5 years, mean BMI 23.4 kg/m<sup>2</sup>)



Nitinol Compression Staple Fixation across talonavicular joint



Fully threaded 4.0 mm lag screw fixation across talonavicular joint



Functional robotic testing of the hindfoot to assess for clinically relevant biomechanical properties



Compression Loading: 30N to 445N at 89N/sec. Continuous 445N load for 30° plantarflexion to 15° dorsiflexion



Translations and rotations were measured during compression and flexion tests and compared for significant (p<0.05) differences between treatments using paired t-Tests

## Results

### Mean Translation and Rotation for Static Compression

Translation (mm)	Mean Staple	Mean Screw	p-Value
X	0.37	0.12	0.35
Y	-0.15	0.12	0.26
Z	0.61	-0.02	0.12
Rotation			
Roll	0.68	-0.54	<b>0.009*</b>
Pitch	2.04	0.17	0.22
Yaw	7.75	2.18	0.79

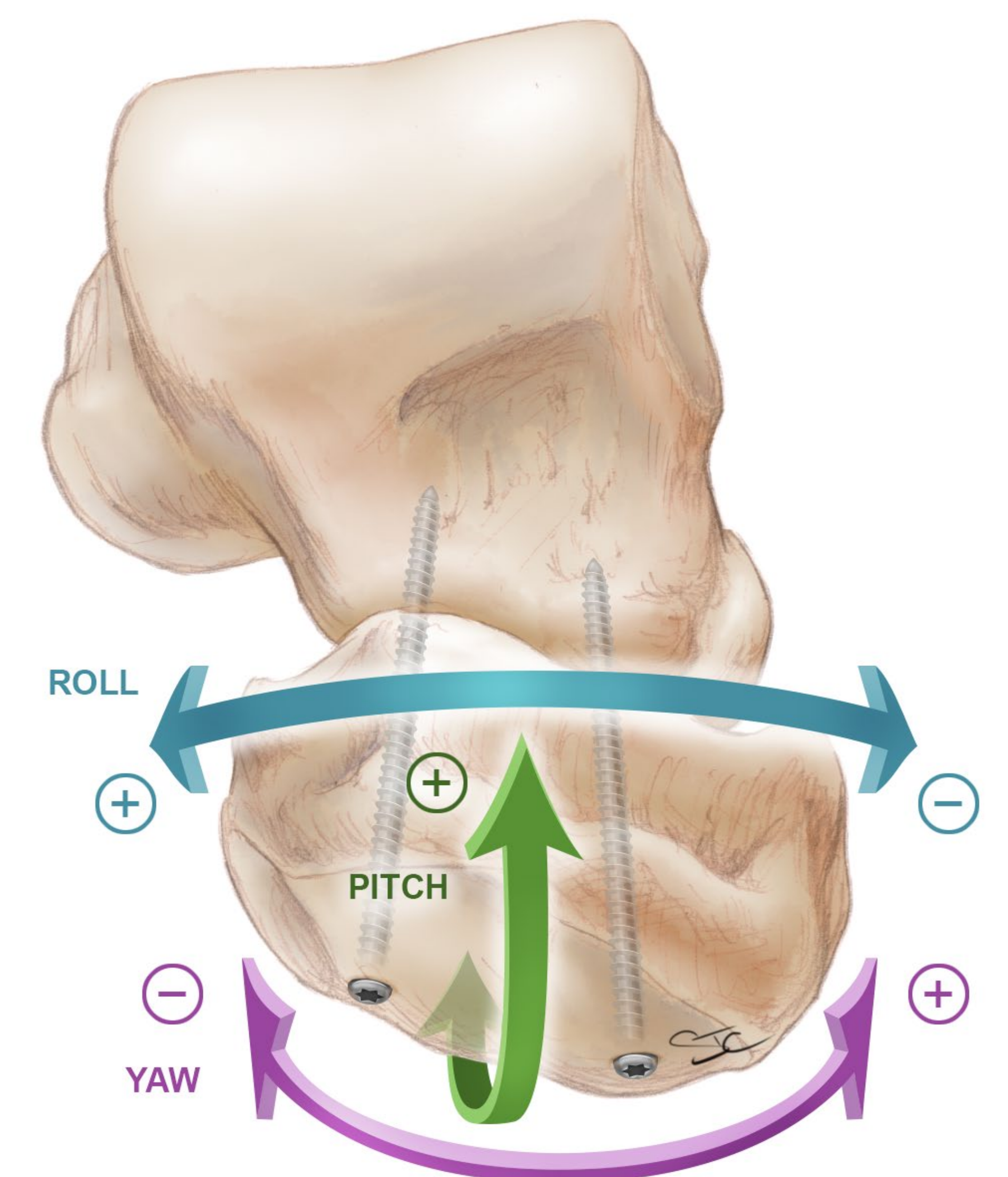
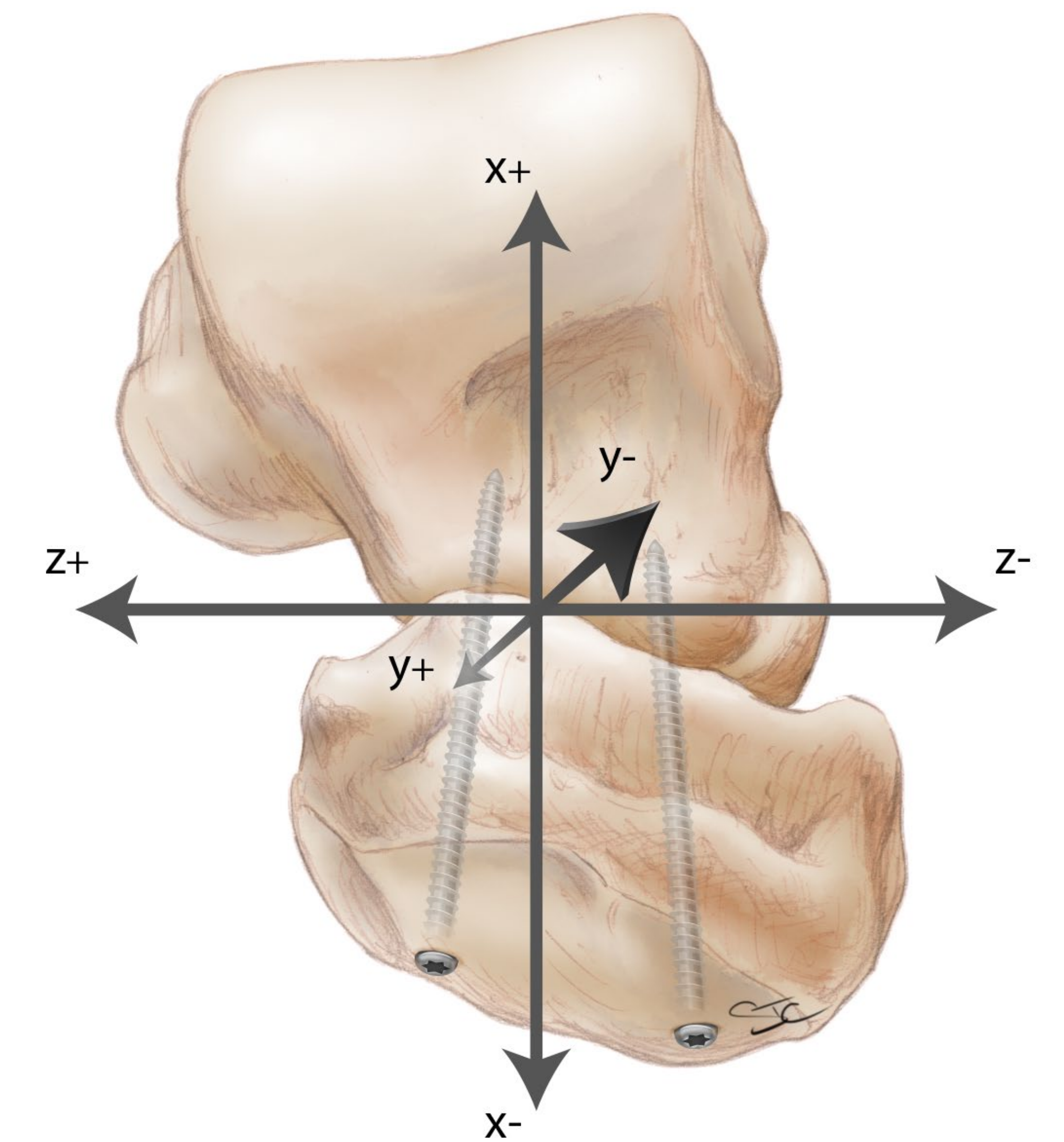
### Mean Translation and Rotation for Plantarflexion

Translation (mm)	Mean Staple	Mean Screw	p-Value
X	-0.1	-0.08	0.43
Y	-1.18	0.64	0.95
Z	0.14	-0.24	0.74
Rotation			
Roll	-1	2.68	0.88
Pitch	1.43	2.4	0.67
Yaw	4.44	1.1	0.82

### Mean Translation and Rotation for Dorsiflexion

Translation (mm)	Mean Staple	Mean Screw	p-Value
X	0.475	0.04	0.27
Y	-0.41	0.19	0.2
Z	0.74	-0.07	0.12
Rotation			
Roll	-1.63	0.14	0.08
Pitch	1.88	-0.25	0.4
Yaw	9.61	2.03	0.83

Nitinol compression staple fixation was associated with significantly greater roll rotation than lag screw fixation (p=0.009). No other statistically significant differences were noted.



## Conclusions

- The results from this study suggest that nitinol compression staples are similar to fully threaded lag screws when used for talonavicular arthrodesis based on clinically relevant biomechanical testing parameters.
- Nitinol compression staples are associated with initial fixation properties that are sufficient for induction of talonavicular arthrodesis.
- Nitinol compression staples are an appropriate option for talonavicular arthrodesis in patients and may have important advantages over other fixation methods.