



Clinical and Biomechanical Results of Suture Button Fixation for Treatment of Ligamentous Lisfranc Injury: A Systematic Review and Meta-Analysis

Deepak V. Chona MD¹, Caroline Park MD², Billy I Kim BA², Brian C.
Lau MD²

¹Stanford University Orthopaedic Surgery; ²Duke University
Orthopaedic Surgery



Duke Orthopaedics



Disclosures

Brian C. Lau, MD

- **Educational Support:** Smith +Nephew; SouthTech Orthopedics
- **Grant:** Zimmer Biomet Holdings; DJO
- **Hospitality:** Wright Medical; SouthTech Orthopedics; Crossroads Extremity Systems; Stryker

No disclosures for the other authors



Purpose

- Ligamentous Lisfranc injury has serious implications if treated inappropriately
- Optimal fixation strategy remains unclear
- To investigate the biomechanical, clinical, radiographic results and meta-analysis of post op outcomes for flexible ligamentous Lisfranc fixation



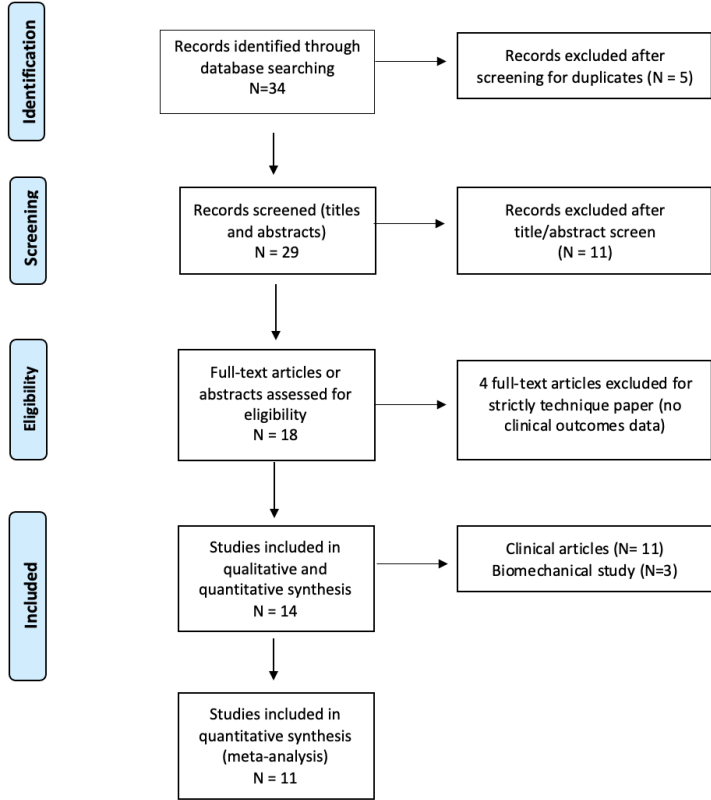
Materials & Methods

- Literature review conducted according to PRISMA search guidelines
- Primary outcome measures: return to activities
- Secondary outcome measures: AOFAS, VAS, patient satisfaction, radiographic alignment, revisions/failures, complications



Materials & Methods

PRISMA search





Results

- 14 studies included
 - 11 clinical studies (n=216; mean age 36.7 yrs; mean f/u 25.4 months)
- Excellent clinical outcomes; no complications or subsequent hardware removals
- 100% maintained radiographic alignment at final follow up (n=62; 6 studies)

Meta-analysis of clinical results of suture button fixation

	AOFAS	VAS	Return to Activity	Radiographic Results
Result	90.1	1.5	100% return	100% maintained alignment
Number	150	137	35	62
Mean Age (years)	37.7	38.5	29.1	34.2
Time of survey (months)	30.7	30.8	NR	NR
Number of Studies	6	5	5	6



Results

- Biomechanical studies (n=3; 27 feet) yielded mixed results when comparing diastasis in cadaver models
- Limited focus on abduction stress testing

Biomechanical results

Publication	Number of Feet	Comparison	Measurements	Load	Results	Conclusion
Ahmed 2010 ¹	8	Suture button vs 4.0 mm partially threaded cannulated screw C1-MT2	M1-M2 distance Load to failure	Axial: 600N Load to failure: 50 mm/minute	*Fixed vs Intact Loaded: Screw Mean Diastasis: -0.1 mm Suture button Mean Diastasis: +1.1 mm *Fixed Loaded vs Fixed Unloaded measurements: Screw Diastasis: -0.2 mm Suture Button: -1.2 mm Load to failure: no difference	Screw results in less displacement than suture button in isolated Lisfranc ligament injuries
Panchbhavi 2009 ²⁷	14	Suture button vs 3.5 mm cannulated lag screw C1-MT2	C1-MT2 Lisfranc ligament attachment sites displacement	Axial: 343 N	*Cut unfixed +1.2 mm difference from screw fixation *Cut unfixed +1.0 mm difference from suture button fixation Screw vs suture button difference not significant (Screw 0.2 mm less)	Suture button and screw do not differ significantly in displacement in isolated Lisfranc ligament injuries
Pelt 2011 ²⁸	5	Suture button C1-MT2 with K-wire MT2-C2 vs 3.5 mm full threaded cortical screw x2 – C1-MT2, MT2-C2	C1-MT2 distance	Axial: 222.4 N Abduction: 50 N 1000 cycles, then retested	*Abduction load yields greater displacement than axial after injury (6.8 vs 2.0 mm) Axial Load: Screw/suture button versus intact not significant (2.0/1.8 vs 1.0 mm) Suture button versus screw not significant (1.8 vs 2.0 mm) Abduction Load: Screw vs intact not significant (1.1 vs 1.5 mm) Suture Button vs intact not significant (2.1 vs 1.5 mm) Cyclic Loading: Suture button/Screw pre vs post 1000 cycles not significant	Abduction stress results in greater motion than axial Suture button and screw fixation states do not differ significantly in displacement compared to intact states in ligamentous Lisfranc injuries



Conclusion

- Flexible fixation for ligamentous Lisfranc has significant potential as viable fixation option based on excellent clinical and radiographic results
- Biomechanical results remain inconclusive
- Prospective randomized clinical trial comparing flexible fixation to screw fixation would be beneficial



References

1. Ahmed S, Bolt B, McBryde A. Comparison of standard screw fixation versus suture button fixation in Lisfranc ligament injuries. *Foot Ankle Int.* 2010;31(10):892-896.
2. Aronow MS. Treatment of the missed Lisfranc injury. *Foot Ankle Clin.* 2006;11(1):127-142, ix.
3. Bansal A, Carlson DA, Owen JR, et al. Ligamentous Lisfranc Injury: A Biomechanical Comparison of Dorsal Plate Fixation and Transarticular Screws. *J Orthop Trauma.* 2019;33(7):e270-e275.
4. Boffelli TJ, Pfannenstern RR, Thompson JC. Combined medial column primary arthrodesis, middle column open reduction internal fixation, and lateral column pinning for treatment of Lisfranc fracture-dislocation injuries. *J Foot Ankle Surg.* 2014;53(5):657-663.
5. Briceno J, Stupay KL, Moura B, Velasco B, Kwon JY. Flexible fixation for ligamentous lisfranc injuries. *Injury.* 2019;50(11):2123-2127.
6. Brin YS, Nyska M, Kish B. Lisfranc injury repair with the TightRope device: a short-term case series. *Foot Ankle Int.* 2010;31(7):624-627.
7. Charlton T, Boe C, Thordarson DB. Suture Button Fixation Treatment of Chronic Lisfranc Injury in Professional Dancers and High-Level Athletes. *J Dance Med Sci.* 2015;19(4):135-139.
8. Cho J, Kim J, Min TH, et al. Suture Button vs Conventional Screw Fixation for Isolated Lisfranc Ligament Injuries. *Foot Ankle Int.* 2021;42(5):598-608.
9. Chun DI, Kim J, Min TH, et al. Fixation of isolated Lisfranc ligament injury with the TightRope: A technical report. *Orthop Traumatol Surg Res.* 2021;107(6):102940.
10. Cook JJ, Cook EA, Rosenblum BI, Landsman AS, Roukis TS. Validation of the American College of Foot and Ankle Surgeons Scoring Scales. *J Foot Ankle Surg.* 2011;50(4):420-429.
11. Cottom JM, Graney CT, Sisovsky C. Treatment of Lisfranc Injuries Using Interosseous Suture Button: A Retrospective Review of 84 Cases With a Minimum 3-Year Follow-Up. *J Foot Ankle Surg.* 2020;59(6):1139-1143.
12. Cottom JM, Hyer CF, Berlet GC. Treatment of Lisfranc fracture dislocations with an interosseous suture button technique: a review of 3 cases. *J Foot Ankle Surg.* 2008;47(3):250-258.
13. Cottom JM, Hyer CF, Philbin TM, Berlet GC. Treatment of syndesmotic disruptions with the Arthrex Tightrope: a report of 25 cases. *Foot Ankle Int.* 2008;29(8):773-780.
14. Crates JM, Barber FA, Sanders EJ. Subtle Lisfranc subluxation: results of operative and nonoperative treatment. *J Foot Ankle Surg.* 2015;54(3):350-355.
15. Delman C, Patel M, Campbell M, Kreulen C, Giza E. Flexible Fixation Technique for Lisfranc Injuries. *Foot Ankle Int.* 2019;40(11):1338-1345.
16. den Daas A, van Zuuren WJ, Pelet S, van Noort A, van den Bekerom MP. Flexible stabilization of the distal tibiofibular syndesmosis: clinical and biomechanical considerations: a review of the literature. *Strategies Trauma Limb Reconstr.* 2012;7(3):123-129.
17. Gallagher EJ, Liebman M, Bijur PE. Prospective validation of clinically important changes in pain severity measured on a visual analog scale. *Ann Emerg Med.* 2001;38(6):633-638.
18. Gee S, C. HM, C. A, A. G. P. R. Lisfranc open reduction and internal fixation in an athletic population: Screw versus suture button fixation. *Current Orthopaedic Practice.* 2019;30(4):323-326.
19. Granberry WM, Lipscomb PR. Dislocation of the tarsometatarsal joints. *Surg Gynecol Obstet.* 1962;114:467-469.
20. Heyrani N, Hopkins JN, Ngyuyen KN, Kreulen C, Giza E. Flexible Fixation Treatment Strategies for Low-energy Lisfranc Injuries. *Techniques in Foot and Ankle Surgery.* 2019;18(1):23-28.
21. Hopkins J, Heyrani N, Kreulen C, et al. InternalBrace has Comparable Stiffness and Strength as Tightrope for Lisfranc Fixation. *AOFAS Annual Meeting 2017 Abstract.*
22. Hopkins J, Nguyen K, Heyrani N, et al. InternalBrace has biomechanical properties comparable to suture button but less rigid than screw in ligamentous lisfranc model. *J Orthop.* 2020;17:7-12.
23. Jain K, Drampalos E, Clough TM. Results of suture button fixation with targeting device aid for displaced ligamentous Lisfranc injuries in the elite athlete. *Foot (Edinb).* 2017;30:43-46.
24. Jensen MP, Chen C, Brugger AM. Interpretation of visual analog scale ratings and change scores: a reanalysis of two clinical trials of postoperative pain. *J Pain.* 2003;4(7):407-414.
25. Kreulen C, Golshani B, Nikpour A, et al. Radiographic Outcomes of Lisfranc Injuries Treated with a Suture Button Device. *AOFAS Annual Meeting 2019 Abstract.*
26. Nery C, Baumfeld D, Baumfeld T, et al. Comparison of Suture-Augmented Ligamentoplasty to Transarticular Screws in a Lisfranc Cadaveric Model. *Foot Ankle Int.* 2020;41(6):735-743.
27. Panchbhavi VK, Vallurupalli S, Yang J, Andersen CR. Screw fixation compared with suture-button fixation of isolated Lisfranc ligament injuries. *J Bone Joint Surg Am.* 2009;91(5):1143-1148.
28. Pelt CE, Bachus KN, Vance RE, Beals TC. A biomechanical analysis of a tensioned suture device in the fixation of the ligamentous Lisfranc injury. *Foot Ankle Int.* 2011;32(4):422-431.
29. Slim K, Nini E, Forestier D, et al. Methodological index for non-randomized studies (minors): development and validation of a new instrument. *ANZ J Surg.* 2003;73(9):712-716.
30. Smith N, Stone C, Furey A. Does Open Reduction and Internal Fixation versus Primary Arthrodesis Improve Patient Outcomes for Lisfranc Trauma? A Systematic Review and Meta-analysis. *Clin Orthop Relat Res.* 2016;474(6):1445-1452.
31. Solan MC, Davies MS, Sakellariou A. Syndesmosis Stabilisation: Screws Versus Flexible Fixation. *Foot Ankle Clin.* 2017;22(1):35-63.
32. Thorne B, Walsh A, Hislop M, Murray P, O'Brien M. Suture-endobutton fixation of ankle tibio-fibular diastasis: a cadaver study. *Foot Ankle Int.* 2003;24(2):142-146.
33. Tzatzairis T, Firth G, Parker L. Adolescent Lisfranc injury treated with TightRope(TM): A case report and review of literature. *World J Orthop.* 2019;10(2):115-122.
34. Watson TS, Shurnas PS, Denker J. Treatment of Lisfranc joint injury: current concepts. *J Am Acad Orthop Surg.* 2010;18(12):718-728.
35. Yongfei F, Chaoyu L, Wenqiang X, et al. Clinical outcomes of Tightrope system in the treatment of purely ligamentous Lisfranc injuries. *BMC Surg.* 2021;21(1):395.