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Original Research

Complications of Metatarsal Suture Techniques for Bunion Correction: A Systematic Review of the Literature

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ABSTRACT

To better understand the safety of suture techniques to reduce the intermetatarsal angle in patients with hallux valgus deformity, we undertook a systematic review of the complications associated with the use of this technique. The suture procedures of 197 patients were analyzed for complications. The number of complications in the total group (n = 197) at a pooled mean follow-up period of 23.2 months was 39 (19.8%) and included 21 fractures (10.7%), 11 cases of hardware failure (5.6%), and 7 cases of hallux varus (3.6%). The cohort of patients was further categorized by the specific procedure technique. The number of complications in the Mini TightRope® group (n = 132) at a pooled mean follow-up period of 16.2 months was 33 (25%) and included 18 fractures (13.6%), 10 cases of hardware failure (7.6%), and 5 cases of hallux varus (3.8%). The number of complications in the syndesmosis technique group (n = 65) at a pooled mean follow-up period of 56.1 months was 6 (9.2%) and included 3 fractures (5%), 1 case of hardware failure (1.5%), and 2 cases of hallux varus (3%). From our review of the published experience with this technique, a high complication rate can be expected.

Hallux abducto valgus (HAV) is one of the most common deformities seen in foot and ankle practice. More than 100 different surgical techniques have been described in published studies to correct this deformity. Osseous procedures, including osteotomies and arthrodesis, are common forms of correction. The use of metatarsal binding techniques using tendon, steel suture, and other suture materials to close the intermetatarsal angle (IMA) have been used for more than a century, with the proposed benefits of a decreased incidence of the complications associated with osseous procedures such as delayed union and nonunion and allowing for faster recovery (1–11). The use of a cerclage technique to correct an increased IMA was originally described by Lexer in 1919 and used a single suture to approximate the first and second metatarsal (12). Since that report, several variations of this technique have been described using a variety of materials and operative techniques but all having in common the main goal of binding the first and second metatarsals to reduce the deformity and maintain the correction (12). More recently, the use of a Mini TightRope® (Arthrex Inc., Naples, FL) (13) or a syndesmosis procedure using suture material has been reported and has been purported to eliminate the need for an osteotomy, thereby eliminating the complications associated with osseous procedures (1–11,13). Complications such as recurrence, metatarsal fracture, and implant failure have become well known with this procedure. To better understand the rate of complications for this technique, we undertook a systematic review of the published data for the suture method of HAV correction.

Materials and Methods

We performed a systematic review of electronic databases, including PubMed (available at: http://www.ncbi.nlm.nih.gov/pubmed), OvidSP (available at: http://ovidsp.ovid.com), Google Scholar (available at: http://scholar.google.com) SCOPUS (available at: http://www.scopus.com), and Cochrane Central Register of Controlled Trials (available at: http://www.thecochranelibrary.com). The search terms used were "Mini TightRope," "suture button fixation," "interosseous suture," "tension wire," "cerclage technique," "EndoButton FiberWire," and "syndesmosis procedure." Additional search terms used were "bunion" OR "hallux valgus" OR "intermetatarsal angle" OR "metatarsus primus varus." Restrictions included journal articles published in the English language or translated into English only and human studies. Two of us initially assessed the trial quality by abstract review, and pertinent studies were selected for full review by all 3 of us independently (P.D., M.F., S.S.). Agreement was achieved on the studies to be included in the present review and the level of evidence. A manual search of the common foot and ankle journals and general surgical references was completed and a bibliography search was conducted of all available references. The studies that were determined to be level 1, 2, 3, or 4 were included. Level 5 studies were excluded. The complication rate was then calculated from the collected data and is reported as a percentage of the total number of procedures.

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Table 1
Summary of findings from selected studies

Investigator	Study Type	Procedures (n)	Mean Follow-Up (mo)	Age (y)	Fractures (n)	Hardware Failure (n)	Hallux Varus (n)
Almalki et al (1)	Prospective	4	12	30.5 (27 to 42)	0	0	NR
Cano-Martínez et al (2)	Prospective	36	24	49 (37 to 58)	2	2	NR
Holmes and Hsu (3)	Retrospective	14	6	49 (33 to 64)	1	0	NR
Kayiaros et al (4)	Retrospective	44	6.6	53.6 (19 to 76)	2	2	2
Kemp et al (5)	Case	1	30	73	1	1	0
Mader and Han (6)	Case	2	5	22	2	0	0
Ponnapula and Wittock (7)	Retrospective	5	20	51 (16 to 71)	2	3	1
Weatherall et al (8)	Retrospective	25	22.5	60 (42 to 78)	8	2	2
West (9)	Case	1	18	68	0	0	0
Wong et al (10)	Retrospective	54	26.4	46 (18 to 70)	3	1	0
Wu (11)	Retrospective	11	85.7	42.2 (23 to 56)	0	0	2
Total	—	197	—	—	21	11	7

Abbreviation: NR, not reported.
Data in parentheses are ranges.

Results

Our search yielded 18 potential references, of which 11 (61%) were included in the final review after applying the inclusion criteria. We were unable to obtain one of the studies with the resources available to us (14). Specifically, 11 evidence-based medicine level 4 studies were obtained and met our inclusion criteria. All references were obtained and reviewed in June 2014. A total of 197 procedures were included, all either a Mini TightRope® device (n = 132; 67%) or a syndesmosis procedure with the use of suture material (n = 65; 33%). The number of complications in the total group (n = 197) at a mean follow-up period of 23.2 months was 39 (19.8%) and included both stress and complete fractures (n = 21; 10.7%), hardware failure (n = 11; 5.6%), and hallux varus (n = 7; 3.6%). Several of the studies did not specifically differentiate a stress fracture from a complete fracture; thus, all reported fractures were combined for analysis. The number of complications in the Mini TightRope® group (n = 132) at a mean follow-up period of 16.2 months was 33 (25%) and included both stress and complete fractures (n = 18; 13.6%), hardware failure (n = 10; 7.6%), and hallux varus (n = 5; 3.8%). The number of complications in the syndesmosis group (n = 65) at a mean follow-up period of 56.1 months was 6 (9.2%) and included stress and complete fractures (n = 3; 5%), hardware failure (n = 1; 1.5%), and hallux varus (n = 2; 3%). Not all studies reported the incidence of hallux varus.

Owing to the lack of statistical analysis and the reporting of statistical variation data in these studies, a meta-analysis was determined to not be appropriate or feasible. Additionally, owing to the low number of reported procedures and the variation in the procedure techniques, a statistical comparison of the 2 techniques was not performed, because the results would have had no clinical significance.

Discussion

The purpose of the present review was to evaluate the complication rate with the use of suture fixation as an option for the correction of the IMA in HAV. The studies in our review included 2 prospective trials, including 1 study with 4 Mini TightRope® procedures (1) and 1 study with 36 Mini TightRope® procedures (2). The 6 retrospective studies included 1 study with 14 Mini TightRope® procedures, 1 with 44 Mini TightRope® procedures (4), 1 with 5 Mini TightRope® procedures (7), 1 with 25 Mini TightRope® procedures (8), 1 with 54 syndesmosis procedures (10), and 1 with 11 syndesmosis procedures (11). Three case studies were included, with a total of 4 Mini TightRope® procedures (5,6,9). These 11 studies had a 19.8% complication rate, including second metatarsal fractures, hardware failure, and hallux varus (Tables 1 and 2). Of these 11 studies, 9 used the Mini TightRope® device. In the 9 studies, the complication rate was 25% within a mean follow-up period of 16.2 months. The remaining 2 studies used the syndesmosis procedure, with a reported complication rate of 9.2% and a mean follow-up period of 56.1 months. The report that could not be obtained (14) included only 3 procedures; therefore, its inclusion would have had very little effect on the results of our review. Our results showed a relatively high complication rate with the use of these devices, suggesting that the use of suture fixation to correct the IMA in HAV is not a safe and reliable surgical option. Not all studies reported hallux varus; therefore, the actual complication rate might have been greater than what was calculated in the present study. Also, the follow-up period for the present data set was very low and, realistically, the long-term failure and complication rates would be expected to be much greater. Additionally, this procedure has been in use for a substantial period; however, only 200 cases, including the report we could not obtain, have been reported in the English published data. This is an extremely low number of reported procedures and begs the question regarding why more reports have not been published if this is a safe and successful procedure.

Other limitations of the present systematic review included the omission of non-English language reports, which excluded studies in foreign languages. Finally, the electronic search might not have uncovered all the studies relevant to cerclage procedures.

In conclusion, our systematic review of studies reporting the use of suture fixation for the correction of an increased IMA in HAV revealed a high rate of complication associated with the use of suture fixation for the correction of HAV; therefore, the use of this technique should be carefully considered.

Table 2
Comparison of mean follow-up period and complications for each procedure type

Procedure	Procedures (n)	Mean Follow-Up (mo)	Fractures (n)	Hardware Failure (n)	Hallux Varus (n)	Total Complications (n)
Both	197	23.2	21 (10.7)	11 (5.6)	7 (3.6)	39 (19.8)
Mini TightRope®	132	16.2	18 (13.6)	10 (7.6)	5 (3.8)	33 (25)
Syndesmosis	65	56.1	3 (5)	1 (1.5)	2 (3)	6 (9.2)

Data in parentheses are percentages.

References

1. Almalki TH, Alrabai HM, Algarni AD, Al-Ahaideb A. Radiological evaluation of hallux valgus after application of Mini TightRope: short-term results. J Taibah Univ Med Sci 9:41–44, 2014.
2. Cano-Martínez JA, Picazo-Marin F, Bento-Gerard J, Nicolas-Serrano G. Treatment of moderate hallux valgus with a Mini TightRope®: a modified technique. Rev Esp Cir Ortop Traumatol 55:358–368, 2011.
3. Holmes GB Jr, Hsu AR. Correction of intermetatarsal angle in hallux valgus using small suture button device. Foot Ankle Int 34:543–549, 2013.
4. Kayiaros S, Blankenhorn BD, Dehaven J, Van Lancker H, Sardella P, Pascalides JT, DiGiovanni CW. Correction of metatarsus primus associated with hallux valgus deformity using the Arthrex Mini TightRope: a report of 44 cases. Foot Ankle Spec 4:212–217, 2011.
5. Kemp TJ, Hirose CB, Coughlin MJ. Fracture of the second metatarsal following suture button fixation device in the correction of hallux valgus. Foot Ankle Int 31:712–716, 2010.
6. Mader DW, Han NM. Bilateral second metatarsal stress fractures after hallux valgus correction with the use of tension wire and button fixation system. J Foot Ankle Surg 4:488e15–488e19, 2010.
7. Ponnapula P, Wittock R. Application of an interosseous suture and button device for hallux valgus correction: a review of outcomes in a small series. J Foot Ankle Surg 49:159e21–159e26, 2010.
8. Weatherall JM, Chapman CB, Shapiro SL. Postoperative second metatarsal fractures associated with suture button implant in hallux valgus surgery. Foot Ankle Int 34:104–110, 2013.
9. West BC. Mini TightRope system for hallux abducto valgus deformity. J Am Podiatr Med Assoc 100:291–294, 2010.
10. Wong DW, Wu DY, Man HS, Leung AK. The use of a syndesmosis procedure for the treatment of hallux valgus: good clinical and radiological results two years post-operatively. Bone Joint J Br 96-B:502–507, 2014.
11. Wu DY. Syndesmosis procedure: a non-osteotomy approach to metatarsus primus varus correction. Foot Ankle Int 28:1000–1006, 2007.
12. Kelikian H. *Hallux Valgus, Allied Deformities of the Foot and Metatarsalgia*, WB Saunders, Philadelphia, 1965, pp. 253–260.
13. Arthrex Inc. *Comprehensive Solutions for Forefoot and Midfoot Surgery Using the Mini TightRope® System*, Arthrex Inc, Naples, FL. Available at: http://www.arthrex.com/foot-ankle/mini-tightrope. Accessed June 14, 2014.
14. Angthong C, Kanitnate S, Angthong W. Hallux valgus correction using a Mini TightRope device: a report of the short-term outcomes in 3 feet. J Med Assoc Thailand 94:S66–S72, 2011.