Time Analysis for Screw Application: Traditional Lag Technique *Versus* Self-Tapping Lag Technique

A study was conducted to compare the procedural time of a 2.7-mm. fully threaded cortical screw versus a self-tapping, 2.4-mm. lag screw, which is reported to eliminate the need for overdrilling and tapping. The screws were applied by four board-certified podiatric and orthopedic physicians and four second-year podiatric and orthopedic residents. Each screw was placed through two 8-mm. layers of Last-a-foam[1], and the participants were timed for length of application of four screws from each system per week. The trials were repeated weekly for 4 weeks. The results showed a statistically significant difference between the length of time for insertion between a traditional cortical screw and a self-tapping lag screw, regardless of physician experience. (The Journal of Foot & Ankle Surgery 36(6):422–424, 1997)

Key words: screw application, lag-screw technique

Joseph V. Gonzalez, BS[2]
Bryan M. Trout, BA[3]
Rodney M. Stuck, DPM[4]
Lori A. Vrbos, MS, RN[5]

The lag-screw technique is often used for the fixation of metatarsal osteotomies. A partially threaded cancellous screw or a fully threaded cortical screw with an overdrill of the proximal fragment may be used. The goal of this technique is to produce adequate interfragment compression to maximize healing. Compression is achieved across the osteotomy as the screw head seats and pulls the proximal fragment against the distal fragment. However, if there is thread purchase within the proximal fragment, it cannot move in relation to the distal fragment (1). Without proper fixation, metatarsal osteotomies are much more likely to progress to nonunion. The correct application of the lag-screw technique will provide adequate interfragment compression to help eliminate this condition (2). In today's market for services and to abate rising health care costs, a decrease in operating time with no difference in fixation quality would be advantageous. To date, time has not been studied as a function in hardware placement. This study will compare the effect of time for the placement of traditional cortical screws to self-tapping lag screws, which is reported to eliminate the need for countersinking, overdrilling, and tapping. We hypothesized the self-tapping lag screw will require less or equal time for application than the traditional cortical fixation screw.

Materials and Methods

The screws were applied by four board-certified podiatric and orthopedic physicians and four second-year podiatric and orthopedic residents. Each screw was placed through two 8-mm. layers (total = 16-mm. thickness) of 10 to 12 pound density Last-a-foam. Last-a-foam is a polyether-polyurethane foam that is readily available and that has been shown to be a suitable replacement for human trabecular bone in orthopedic research. It has comparable strength and density ranges, as well as consistent material properties, with small deviations from means (3).

Fully threaded cortical screws, 2.7 mm. in length, and 2.4-mm. self-tapping lag screws (Osteomed Corporation) (Fig. 1) were applied using the appropriate lag technique. The steps required for fixation using the "standard" lag technique, with a fully threaded cortical screw are as follows: 1) drill pilot hole; 2) countersink; 3) drill-gliding hole (overdrill); 4) depth gauge; 5) tap; and

From the Department of Orthopaedic Surgery, Loyola Medical Center, Maywood, IL, and Hines Veterans Administration Hospital, Hines, IL.

[1] General Plastics Manufacturing Co., Tacoma, WA.

[2] Submitted during third year at Scholl College of Podiatric Medicine, Chicago, IL.

[3] Submitted during fourth year at Scholl College of Podiatric Medicine, Chicago, IL.

[4] Chief, Section of Podiatry, Hines VA Hospital, Hines, IL, and Assistant Professor, Department of Orthopaedic Surgery, Loyola University Medical Center, Maywood, IL. Address correspondence to: Department of Orthopaedic Surgery, Loyola University Medical Center, 2160 South First Avenue, Maywood, IL 60153.

[5] Clinical Specialist, Department of Orthopaedic Surgery, Loyola University Medical Center, Maywood, IL, and Research Associate, Section of Research, Rehabilitation, and Development, Hines VA Hospital, Hines, IL.

The Journal of Foot & Ankle Surgery 1067-2516/97/3606-0422$3.00/0

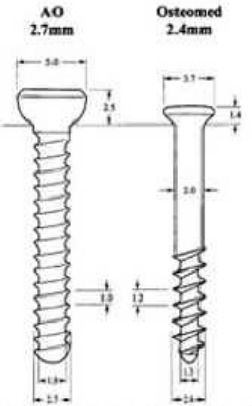

FIGURE 1 Screw comparison between the 2.7-mm. fully threaded cortical screw and the 2.4-mm. self-tapping lag screw (redrawn from the Osteomed M3-X extremity fixation manual).

LAG SCREW TECHNIQUE

Fully Threaded Screw	Osteomed Screw
1. Drill pilot hole	1. Drill pilot hole
2. Drill gliding hole	
3. Countersink	2. Countersink (optional)
4. Measure depth	3. Measure depth
5. Tap threaded hole	
6. Insert screw	4. Insert screw

FIGURE 2 Procedures for application of the self-tapping lag screw versus the cortical screw systems (redrawn from the Osteomed M3-X extremity fixation manual).

6) insert screw. The more recent self-tapping 2.4-mm. lag-screw technique requires the following procedural steps: 1) drill pilot hole; 2) countersink; 3) depth gauge; and 4) insert screw (Fig. 2).

The participants were timed for length of application of the four screws for each type, per experimental trial. The sessions were held at 1-week intervals over a period of 4 weeks. This yielded a total of 32 timed sessions and a total application of 128 screws per screw type. Screw placement and adequacy of fixation were evaluated by the principal investigator (RS) after each weekly trial.

After 4 weeks, the data was compiled, reviewed descriptively, and analyzed for screw type, the statistical effects between each weekly trial, and the differences between attending and resident physicians. For each system, the mean was calculated along with the standard error of the mean (SEM). A repeated measures analysis of variance was used with a prespecified alpha coefficient of 0.05. The alpha was adjusted to account for repeated testing.

TABLE 1 **Average length of insertion time for four 2.7-mm. fully threaded cortical screws versus four 2.4-mm. self-tapping lag screws**

System	Week	Mean (minutes)	SEM
2.7-mm. cortical screw	1	3.527	0.2795
2.7-mm. cortical screw	2	3.361	0.2795
2.7-mm. cortical screw	3	3.008	0.2795
2.7-mm. cortical screw	4	2.856	0.2795
2.4-mm. lag screw	1	2.134	0.2795
2.4-mm. lag screw	2	2.107	0.2795
2.4-mm. lag screw	3	1.855	0.2795
2.4-mm. lag screw	4	1.660	0.2795

Experiments were performed by four board-certified podiatric and orthopedic physicians and four second year podiatric and orthopedic residents.

TABLE 2 **Four-week average insertion time of four cortical *versus* four self-tapping screws**

System	Mean (minutes)	SEM
2.7-mm. cortical screw	3.18	0.1397
2.4-mm. lag screw	1.93	0.1397

Experiments were based on 32 timed sessions with each screw type.

TABLE 3 **Average weekly insertion times of the 2.7-mm. cortical screw and 2.4-mm. lag screw systems combined**

Week	Mean (minutes)	SEM
1	2.831	0.19768
2	2.734	0.19768
3	2.431	0.19768
4	2.258	0.19768

Results

There was a definite statistically significant difference between the length of time for insertion of the 2.7-mm. cortical screws *versus* the time of insertion for the 2.4-mm. self-tapping lag screw (Table 1) [F 1, 63 = 43.42; $p < 0.001$]. Also, there was a statistically significant difference between the weekly trials (Table 2), noting that the physicians appeared to require less time to apply fixation over the length of the trial (Table 3) [F 3, 63 = 34.13; $p = 0.0081$]. Further, differences in surgical experience did not have a statistically significant effect [$F = 3, 48 = 1.73$; $p = 0.4139$], as ease of insertion was found to be equal for both groups (Table 4).

Discussion

This study was performed in order to identify whether or not a self-tapping lag screw would save a statistically

TABLE 4 Four-week average insertion time for each system (Attendings versus Residents)

System	Surgeons	Mean (minutes)	SEM
2.7-mm. cortical screw	Attendings	3.109	0.2135
2.7-mm. cortical screw	Residents	3.206	0.1849
2.4-mm. lag screw	Attendings	1.990	0.2135
2.4-mm. lag screw	Residents	1.870	0.1849

significant amount of time for insertion. Clearly, the study shows that the self-tapping lag screw saves significant time for insertion when compared with the cortical method, regardless of physician experience. Both the attending and the resident physicians were able to save approximately one-third of the application time, without sacrificing quality of fixation, when using the self-tapping lag screw system. Furthermore, as the physicians gained experience and familiarity with each system, their application times decreased, although the Osteomed system still required one-third less time. With today's rising health care costs, any time saved in the operating room is extremely beneficial, not only for the patient, but for the physician as well.

Because this study was performed using Last-a-foam instead of bone, there may be some differences when the systems are used with cortical bone.

Conclusion

The study's findings are consistent with the hypothesis that the self-tapping lag screw, which eliminates the need for overdrilling and tapping, reduces a significant amount of surgical time. Thus, depending on the number of screws applied, this could result in notable savings in total operative expenses.

Acknowledgment

The authors thank Todd Sippel and the Osteomed Corporation for supplying the Osteomed and Synthes systems used in this study.

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