

What Is the Optimum Insertion Angle of a Suture Anchor?

In a now classic article, Stephen Burkhart shared lessons learned from his study of a South Texas fence line.¹ On a South Texas ranch, a corner fence post is anchored by a large rock buried under the ground and attached to the fence post by means of a twisted wire attached to the top of the post. This large rock, or “deadman,” serves to keep the fence post from leaning and ultimately falling down. In his infinite wisdom, Dr. Burkhart, a gifted teacher, makes analogies between the deadman and a suture anchor, between the wire and a suture, and between the pull of the fence and the pull of the rotator cuff. These analogies are enormously helpful because the true method of Burkhart’s study was trigonometric, and while trigonometry can be complex, it is fairly simple to visualize a post attached to a wire tied to a rock.

The article has been cited more than 200 times,² and is reprinted in this issue. The conclusion: the pullout strength of a suture anchor is increased when the anchor is inserted obliquely into bone, i.e., at a low angle relative to the direction of the pull of the rotator cuff.¹

Of note, Dr. Burkhart’s analysis was mathematical, and while it made perfect and intuitive sense, especially when visualizing the fence post as above, the analysis did not include biomechanical testing. Thus, in this issue, we share with great interest an original scientific article that reports the testing of the Deadman Theory of suture anchors in the biomechanics lab by Clevenger, Beebe, Strauss, and Kubiak titled “The Effect of Insertion Angle on the Pullout Strength of Threaded Suture Anchors: A Validation of the Deadman Theory.”³

Spoiler alert: Clevenger et al. found that the Deadman Theory is incorrect.

How could this be? How can one argue with trigonometry? For that matter, how can one argue with Dr. Burkhart? For arthroscopic and related clinicians, the issue seems of extreme consequence because, in addition to our editorial infatuation with shoulder rotator cuff controversy,⁴⁻¹⁵ and as noted by Clevenger et al.,³ “suture anchors have become one of the most commonly used methods for securing soft tissues to

bone..., (and) their use is described in almost every site of the tendinous insertion in the body.”

What first comes to mind, and as we have asked in past, “Do basic science articles have clinical relevance?”¹⁶ The answer depends on the methods, and we note without judgment that Clevenger et al.³ test failure of metallic threaded anchors in polyurethane foam block and do not test other known modes of clinical failure of tendon repair, such as suture breakage, knot slippage, or suture cutting through tendon. Nevertheless, the question at hand is failure of the anchor, and regardless of anchor or bone substitute material, trigonometrics should not change. And, to be fair, when considering the methods of Clevenger et al., we should remember that Dr. Burkhart’s inspiration for anchor insertion angle analysis was a deadman, a rock buried in the ground.

To us, Burkhart’s conclusion that the pullout strength of a suture anchor is increased when the anchor is inserted obliquely into bone relative to the direction of the pull of the soft tissue being repaired makes intuitive sense, and has become arthroscopic dogma. On the other hand, the results of Clevenger et al. do seem clearly at odds with Dr. Burkhart’s conclusion. As editors, we love this disparity: “Controversy in Arthroscopy: Bring it on.”⁷

However, as clinicians and scientists, we prefer clarity. As such, we have written to Dr. Burkhart and asked that he be so kind as to write a letter to the editor, sharing his thoughts on the analysis of Clevenger et al. We aim to share Dr. Burkhart’s letter in our September issue. In addition, we would be thrilled, as ever, if other readers join the discussion. Please send us your letters on this controversy (and on any issues).

In the interim, readers are invited to review the classic study,¹ the biomechanical analysis,³ form a provisional opinion, and eagerly await Dr. Burkhart’s letter.

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