CORR Insights

CORR Insights®: The Chitranjan Ranawat Award: Running Subcuticular Closure Enables the Most Robust Perfusion After TKA: A Randomized Clinical Trial

Michael D. Ries MD

Where Are We Now?

Previous research [1, 3, 7, 9, 10] has supported many different wound closure techniques for use in TKA including staples,

This CORR Insights® is a commentary on the article “The Chitranjan Ranawat Award: Running Subcuticular Closure Enables the Most Robust Perfusion After TKA: A Randomized Clinical Trial” by Wyles and colleagues available at: DOI: 10.1007/s11999-015-4209-x.

The author certifies that he, or any member of his immediate family, has no funding or commercial associations (eg, consultancies, stock ownership, equity interest, patent/licensing arrangements, etc) that might pose a conflict of interest in connection with the submitted article.

All ICMJE Conflict of Interest Forms for authors and *Clinical Orthopaedics and Related Research*® editors and board members are on file with the publication and can be viewed on request.

The opinions expressed are those of the writers, and do not reflect the opinion or policy of CORR® or the Association of Bone and Joint Surgeons®.

This CORR Insights® comment refers to the article available at DOI: 10.1007/s11999-015-4209-x.

interrupted sutures, running barbed subcutaneous sutures, and subcuticular methods. A midline incision is generally used, but medial and lateral incisions have also been advocated to permit better kneeling ability after surgery or for other reasons [2, 6].

Subfacial vessels provide circulation to the skin, which perforate through the subcutaneous tissue layer [10]. Subfacial dissection of skin and subcutaneous tissue flaps preserve skin circulation while dissection into the subcutaneous layer disrupts skin circulation. Circulation to the skin over the knee occurs in a medial to lateral direction [12]. Sensory nerve supply follows the same direction. This is why sensation in the lateral skin flap is often diminished after TKA, and the lateral skin edge is generally more hypoxic than the medial skin edge [5].

Oxygenation of the skin edges is also reduced by knee flexion because this puts greater tension on the wound, while also decreasing to a maximum several days after surgery before returning toward normal [5].

The development of skin necrosis and postsurgery wound healing problems can lead to infection of the prosthetic components. These issues are influenced by many risk factors and comorbidities that are not under the control of the surgeon. Surgical technique, including the method of soft tissue dissection and wound closure, are also important in promoting primary wound healing. However, there is no clear consensus on the best method of wound closure in TKA.

The study by Wyles et al. utilizes a sophisticated fluorescent imaging system following intravenous administration of dye to quantitate skin perfusion. This method is a valuable research tool that is more sensitive than other techniques, and also appears to be useful in clinical practice to help with treatment decisions. The authors

M. D. Ries MD (✉)
Tahoe Fracture and Orthopaedic Clinic,
973 Mica Dr., Carson City, NV 89705,
USA
e-mail: riesm@orthosurg.ucsf.edu

CORR Insights

found that subcuticular wound closure was associated with more favorable skin perfusion than staple closure. This is likely related to the more uniform distribution of tension across the wound with a running suture placed into the dermis, which has considerably better mechanical integrity than the subcutaneous fatty layer, in comparison to wound tension with staples that is more concentrated on each point of contact at which the staple enters the skin.

Where Do We Need To Go?

Many factors other than the method of wound closure can affect skin perfusion, including the location and length of the incision, method of soft tissue flap elevation, deep surgical approach to the knee, and patient comorbidities such as diabetes, peripheral vascular disease, and immunosuppressive disorders. However, the relative effect of these various factors on skin perfusion and wound healing after TKA is not clear. Since wound healing problems are not common after TKA, and many factors can contribute to skin perfusion, traditional methods to assess the relative value of each of these factors on wound healing would require multivariate analysis of a large patient population.

How Do We Get There?

Most wound healing problems are likely associated with some impairment in skin vascularity, but not all patients with impaired skin vascularity develop a wound healing problem. Studies using in vivo nuclear vascular imaging provide an assessment of soft tissue perfusion, which is a surrogate of wound healing [4, 8, 11]. This is similar to research studies that evaluate deep venous thrombosis rather than pulmonary embolus after TKA to determine the effects of various prophylactic pharmacologic agents on thromboembolic complications. Researchers have performed these types of studies because deep venous thrombosis is more common than pulmonary embolus—although pulmonary embolus is more clinically relevant.

Nuclear vascular imaging techniques have been used in plastic surgery research and clinical practice [4, 11]. It appears that controlled clinical studies with fluorescent imaging following intravenous administration of dye or similar techniques could be employed at institutions other than the Mayo clinic. Since the method used in the study by Wyles et al. is highly sensitive, it could be used in future controlled studies to determine the effect of various patient related factors or differences in surgical technique on

skin vascularity with relatively small patient populations. Researchers would need a correlation of the measurements of skin perfusion with clinical outcomes in larger patient populations in order to determine the threshold of skin perfusion that is clinically relevant for wound healing in TKA.

References

1. Gililland JM, Anderson LA, Barney JK, Ross H, Pelt CE, Peters CL. Barbed versus standard sutures for closure in total knee arthroplasty: A multicenter prospective randomized trial. *J Arthroplasty*. 2014;29(Suppl):135–138.
2. Goldstein WM, Gordon AC, Branson JJ, Simmons C, Berland KA. Stress over the anterior aspect of the knee with kneeling. *J Bone Joint Surg*. 2007;89A (suppl 3):162–166.
3. Graham DA, Jeffery JA, Bain D, Davies P, Bentley G. Staple vs. subcuticular vicryl skin closure in knee replacement surgery: A spectrophotographic assessment of wound characteristics. *Knee*. 2000;7:239–243.
4. Gurtner GC, Jones GE, Neligan PC, Phillips BT, Zacks JM, Zenn MR. Intraoperative laser angiography using the SPY system: Review of the literature and recommendations for use. *Ann Surg Innov Res*. 2013;7:1.
5. Johnson: Midline or parapatellar incision for knee arthroplasty. A comparative study of wound viability. *J Bone Joint Surg*. 1988;70(B): 656–658.

CORR Insights

6. Laffosse JM, Potapov A, Malo M, Lavigne M, Vendittoli PA. Hypes-thesis after anterolateral versus midline skin incision in TKA: A randomized study. *Clin Orthop Relat Res.* 2011;469: 3154–3163.
7. Sah AP. Is there an advantage to knotless barbed suture in TKA wound closure? A randomized trial in simultaneous bilateral TKAs. [Published online ahead of print January 29, 2015]. *Clin Orthop Relat Res.* DOI: [10.1007/s11999-015-4157-5](https://doi.org/10.1007/s11999-015-4157-5).
8. Sarikaya A, Top H, Aygit AC, Benlier E, Unal Y. Predictive value of 99mTc-sestamibi scintigraphy for healing of extremity amputation. *Eur J Nucl Med Mol Imaging.* 2006;33:1500–1507.
9. Smith EL, DiSegna ST, Shukla PY, Matzkin EG. Barbed versus traditional sutures: Closure time, cost, and wound related outcomes in total joint arthroplasty. *J Arthroplasty.* 2014;29:283–287.
10. Ting NT, Moric MM, Della Valle CJ, Levine BR. Use of knotless suture for closure of total hip and knee arthroplasties: A prospective, randomized clinical trial. *J Arthroplasty.* 2012;27: 1783–1788.
11. Top H, Sarikaya A, Aygit AC, Benlier E, Kiyak M. Review of monitoring free muscle flap transfers in reconstructive surgery: role of 99mTc sestamibi scintigraphy. *Nucl Med Commun.* 2006;27:91–98.
12. Younger ASE, Duncan CP, Masri BA. Surgical exposures in revision total knee arthroplasty. *J Am Acad Orthop Surg.* 1998;6:55–64.