

Value Appraisal of Clarix® 1K for Preventing Post-Surgical Wound Complications after Pilon Fracture Repair

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INTRODUCTION

Pilon fractures are one of the most surgically challenging fractures in orthopedics, representing about 1–5% of lower extremity fractures and 7–10% of all tibial fractures.^{1–3} These fractures typically result from high-energy trauma, e.g., axial compression or shearing injuries, from motor vehicle accidents or falls from heights.⁴ Although a relatively uncommon injury, the combination of high energy trauma, articular comminution, and soft tissue damage render these fractures particularly difficult to manage and can result in poor functional and health outcomes that can have devastating effects on patients' quality of life.^{5–7}

Studies have also shown that complications and outcomes are closely associated with the degree of injury, especially to soft tissues.^{4, 8, 9} Therefore, the goal of treatment is to not only stabilize the fracture and reduce the joint anatomically, but to also preserve the soft tissue envelope.^{4, 8, 9} The most common surgical method in treating pilon fractures is Open Reduction and Internal Fixation (ORIF), which involves substantial soft tissue dissection to visualize the articular surface.¹⁰ Despite the evolution of surgical techniques, a large proportion of patients develop post-operative complications, including wound infection, non-union, and even amputation. Rates of superficial and deep infection range from 9–24%^{11–16} following ORIF for pilon fractures. Furthermore, about 1–10%^{12, 15, 17} have post-operative non-unions. As a result of these complications, patients often require additional surgical treatment. In fact, one study reported a readmission rate of 23% and a reoperation rate of 25% following ORIF for pilon fractures.¹⁶

As a result of longer hospital stays and additional surgeries (e.g., secondary arthrodesis), complications following ORIF result in significantly greater healthcare costs. One study demonstrated that total healthcare costs for patients with deep infection were 6.5 times higher compared to uninfected cases, with 62% of those additional costs due to increased length of stay (hospitalization).¹⁸ Similarly, compared to those who achieve complete union, patients with non-union have nearly 5 times the total health care costs.¹⁸ Furthermore, absence from work following surgical treatment can indirectly increase the economic burden. In one study by Volgas et al,¹⁹ only 30% of the patients undergoing ORIF of the tibial pilon returned to work within 12-months after their injury. Moreover, only 14% of all blue-collar workers were back at work at 12-months postinjury. Given the high complication rate and economic burden, adjunctive measures to expedite healing and reduce the rate of complications following ORIF for pilon fractures are warranted.

ORIF with Adjunctive Clarix

Clarix 1K is a cryopreserved, ultra-thick amniotic membrane allograft that can be used as an adjunct during the surgical management of pilon fractures. Clarix can be placed subcutaneously under the incision site as a surgical barrier to help promote healing, or over exposed muscle prior to closure, to prevent adhesion to the incision site. Our recent study demonstrated that application of Clarix over the exposed muscle prior to closure may support post-operative wound healing and ultimately reduce complications by preventing adhesion to the incision site and subsequent wound dehiscence. In the study, 20 patients (40% smokers) underwent ORIF (n=4) or staged ORIF

(n=16) with adjunctive amniotic membrane derived from the umbilical cord for open (n=7) or closed (n=13) pilon fractures involving the tibial shaft in 3 patients. Within 6-months post-procedure, only 3 (15%) patients had wound complications requiring incision and drainage for superficial (10%) or deep infection (5%), which required limited hardware removal in 2 (10%) patients. No patient required local wound care/antibiotics, and no other readmittances or reoperations were observed. Furthermore, there was only one case of non-union (5%) post-operatively. The low incidence of deep infection and non-union is notable, as these complications affect up to 24% of patients following ORIF.^{11–15, 17} These results provide evidence that the use of Clarix as a surgical barrier can support soft tissue and wound healing, as segmental bone loss and the need for soft tissue coverage have been shown to be the only independent risk factors for deep infection.²⁰ Similarly, studies have shown that non-union is significantly associated with the presence of open fracture, need for soft tissue coverage or bone grafting, and surgical site infection.^{21, 22} Collectively, this data demonstrates that Clarix may be used to provide soft tissue coverage and improve post-operative wound healing, which may ultimately reduce post-surgical complications including deep infection and non-union.

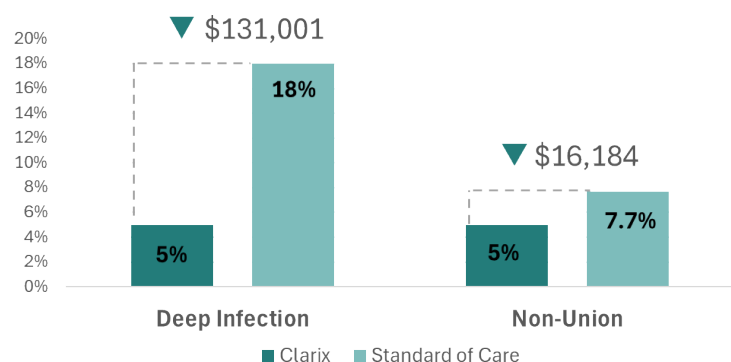
Seeing as operatively treated tibia fractures complicated by deep infection result in the highest increase in total healthcare costs,¹⁸ the associated economic benefit of using Clarix is notable. The calculated median total healthcare cost for patients with a deep infection is 6.5 times higher (or a €37,613 increase in costs) compared to uninfected cases (€44,468 [13,574–71,125] vs. €6,855 [4,899–10,495], respectively).¹⁸ After converting to USD (\$40,719.83) and adjusting for inflation (23.74% from 2016 to 2023), each case of deep infection results in an additional \$50,385. With a median reported deep infection rate of 18% (range: 9–24%^{11–14}), the decreased incidence of deep infection (5%) in our cohort of 20 patients, who were managed with adjunctive Clarix, amounts to significant cost savings of \$131,001. Similarly, patients treated for non-union have nearly 4.5 times the total healthcare costs compared to those who healed without non-union (€6,773 [4,868–10,470] vs. €29,217 [11,849–50,276]), amounting to an additional €22,444 or \$24,221.18. After adjusting for inflation, this amounts to \$29,971. With a median reported non-union rate of 7.7% (range: 1–10%^{12, 15, 17}), this would amount to cost savings of approximately \$16,184 in this cohort of 20 patients who had a non-union rate of 5%. In total, the reduced rates of deep infection and non-union in this study could have ultimately saved up to \$147,185 in complication-associated costs. Overall, Clarix could be considered a cost-effective adjunctive treatment option to support wound healing and reduce complications following ORIF for pilon fractures.

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Complications and Costs Savings Using Clarix®



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