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Review Article

Risk Stratification in Total Ankle Arthroplasty: Patient Factors Predicting Early Failure

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Abstract

Total ankle arthroplasty (TAA) has emerged as a viable alternative to ankle arthrodesis for end-stage ankle osteoarthritis, with 5-year survival rates around 95% and 10-year survival at 91%. However, TAA demonstrates higher complication and failure rates compared to hip and knee arthroplasty, necessitating comprehensive patient risk stratification. This focused review synthesizes current evidence on comorbidity data, age considerations, and preoperative optimization strategies to guide clinical decision-making. Large cohort studies have identified chronic pulmonary disease (adjusted hazard ratio [AHR] 1.476), diabetes mellitus (AHR 1.443), peripheral vascular disease, and younger age (<55 years; AHR 1.725) as significant independent risk factors for early TAA failure. Glycemic control emerges as a critical modifiable factor, with uncontrolled diabetes (HbA1c >7%) associated with substantially elevated periprosthetic infection risk. Additional risk factors include smoking, obesity, mental health comorbidities, and chronic kidney disease. Preoperative optimization strategies including glycemic control targeting HbA1c <7%, nutritional assessment, smoking cessation, and mental health screening represent evidence-based approaches to improve outcomes. Point-based risk stratification systems incorporating multiple comorbidities demonstrate utility in predicting postoperative complications. Contemporary fourth-generation implants with improved fixation designs demonstrate superior survivorship. This review provides clinicians with a comprehensive framework for patient selection, perioperative optimization, and realistic expectation setting to maximize TAA success across diverse patient populations.

Keywords: Total Ankle Arthroplasty; Risk Stratification; Ankle Arthritis; Preoperative Optimization; Comorbidities; Implant Survivorship

Abbreviations

TAA: Total Ankle Arthroplasty; AHR: Adjusted Hazard Ratio; OR: Odds Ratio; HR: Hazard Ratio; CI: Confidence Interval; PJI: Periprosthetic Joint Infection; SSI: Surgical Site Infection; HbA1c: Hemoglobin A1c; BMI: Body Mass Index; COPD: Chronic Obstructive Pulmonary Disease; PVD: Peripheral Vascular Disease; CKD: Chronic Kidney Disease; ASA: American Society of Anesthesiologists; AOFAS: American Orthopaedic Foot and Ankle Society; FAOS: Foot and Ankle Outcome Score; FAAM: Foot and Ankle Ability Measure; MOXFQ: Manchester-Oxford Foot Questionnaire; PHQ-9: Patient Health Questionnaire-9; GAD-7: Generalized Anxiety Disorder-7; eGFR: Estimated Glomerular Filtration Rate; DXA: Dual-energy X-ray Absorptiometry; NSQIP: National Surgical Quality Improvement Program.

Introduction

Total ankle arthroplasty (TAA) has emerged as a viable alternative to ankle arthrodesis for the treatment of end-stage ankle osteoarthritis, offering significant advantages in pain relief and functional preservation compared to fusion procedures. The rapid growth in TAA utilization over the past decade has been

accompanied by substantial improvements in implant design, surgical technique, and long-term outcomes. However, TAA continues to demonstrate higher complication and failure rates compared to hip and knee arthroplasty, with 5-year survival rates around 95% and 10-year survival rates at 91% reported in large population-based cohort studies [1,2]. These outcomes underscore the critical importance of comprehensive patient risk stratification and preoperative optimization strategies to improve surgical success and reduce early complications.

The epidemiology of ankle arthritis differs fundamentally from hip and knee osteoarthritis, with approximately 80% of end-stage ankle arthritis being post-traumatic in nature, often affecting younger, more active patient populations [3,4]. This unique demographic profile creates distinct challenges for patient selection and preoperative planning, as younger patients typically have higher functional demands and longer life expectancies that may exceed implant longevity. Understanding the multifactorial risk profiles that influence TAA outcomes is essential for surgeons to optimize patient selection, tailor perioperative protocols, and establish realistic patient expectations.

Major comorbidity risk factors and disease burden

Chronic pulmonary disease as a risk factor

Chronic obstructive pulmonary disease and other chronic pulmonary conditions have emerged as significant independent risk factors for early TAA failure. In the largest population-based cohort study of 5,619 TAA patients, chronic pulmonary disease demonstrated an adjusted hazard ratio (AHR) of 1.476 for primary TAA failure, with patients experiencing this comorbidity being 48% more likely to require revision surgery or arthrodesis within ten years [1]. The mechanisms underlying this increased risk likely involve compromised wound healing, reduced functional reserve limiting postoperative rehabilitation, and increased infection susceptibility.

Patients with chronic pulmonary disease presented with prolonged hospital stays averaging 0.31 additional days beyond baseline, and multivariate analyses consistently identified COPD as an independent predictor of extended length of stay and readmission risk [5,6]. Preoperative optimization in patients with chronic lung disease should include pulmonary function assessment, optimization of bronchodilator therapy, and consideration of extended perioperative monitoring, particularly during the critical early mobilization period when respiratory demands increase significantly.

Diabetes mellitus and glycemic control

Diabetes mellitus represents one of the most thoroughly studied risk factors in TAA outcomes, with substantial evidence demonstrating its detrimental effects across multiple domains of postoperative morbidity. Meta-analysis of 14 studies involving over 20,000 patients demonstrated that diabetic patients had significantly higher revision rates (5.0% vs 3.8%, $p < 0.001$), postoperative infection rates, 30-day readmission rates, and longer hospital stays compared to non-diabetic cohorts [7]. At 5-year follow-up, diabetic patients demonstrated a periprosthetic joint infection (PJI) rate of 7.3% compared to 3.9% in non-diabetic patients, with a 95% increased hazard ratio for infection (HR 1.95, 95% CI 1.15-3.30) [8].

Critically, recent research has identified that the diabetes-associated infection risk may be primarily attributable to inadequate glycemic control rather than diabetes per se. A propensity-matched analysis of diabetic TAA patients demonstrated that 60% of those who developed PJI had uncontrolled diabetes (HbA1c >7%), compared to only 6.7% of non-infected diabetic controls [9]. This finding has profound implications for preoperative optimization, suggesting that intensive perioperative glucose management targeting HbA1c levels ≤7% may substantially reduce infection risk. The differential risk between insulin-dependent and non-insulin-dependent diabetes was notable, with insulin-dependent diabetes conveying 6.47-fold increased odds of 30-day infection (95% CI 0.79-33.66) [10].

Peripheral vascular disease

Peripheral vascular disease (PVD) has been identified as a significant risk factor for TAA failure, though it remains understudied compared to other comorbidities. The presence of clinically significant PVD correlates with impaired tissue healing capacity, increased infection susceptibility, and compromised functional outcomes. While specific TAA-focused data on PVD is limited, evidence from lower extremity joint arthroplasty and orthopedic trauma literature consistently demonstrates that patients with PVD experience higher rates of wound complications, infections, and delayed healing. Preoperative vascular assessment

is warranted in patients with symptomatic claudication, rest pain, or prior lower extremity vascular interventions, and close coordination with vascular medicine specialists may be necessary for high-risk patients.

Age-related outcomes and younger patient considerations

Age as a paradoxical risk factor

Perhaps counterintuitively, younger age at the time of TAA has emerged as an independent risk factor for early implant failure and complications, demonstrating an adjusted hazard ratio of 1.725 for patients under 55 years compared to those 65-74 years old [1]. In a single-institution series of 1,185 TAA patients, those under age 55 demonstrated significantly higher rates of all complications (33.8% vs 23.1% vs 19.8% for ages <55, 55-70, and >70 respectively, p = 0.001), implant failure (9.1% vs 6.0% vs 3.2%, p = 0.022), and component removal (5.0% vs 2.8% vs 1.1%, p = 0.030) [4]. Additionally, younger patients reported the worst functional outcome scores across multiple validated instruments including the American Orthopaedic Foot and Ankle Society (AOFAS) hindfoot score and the Foot and Ankle Outcome Score (FAOS) subscales.

The mechanisms underlying this paradoxical age effect likely include several interrelated factors. Younger patients typically have higher functional demands and greater activity levels postoperatively, potentially subjecting implants to greater biomechanical stress. Additionally, younger patients with post-traumatic ankle arthritis often have complex surgical histories including prior fractures, soft tissue injuries, and sometimes failed previous interventions, creating more challenging anatomic conditions for arthroplasty. Younger patients also demonstrate a propensity toward gutter impingement complications, with those under 55 years experiencing significantly higher impingement rates (20.8%) compared to those aged 55-70 (13.5%) and over 70 (7.2%), potentially related to more vigorous scar tissue formation and greater inflammatory response to surgery [11].

Despite these increased early complication rates, several large series have demonstrated that appropriately selected younger patients (<50 years) with adequate preoperative counseling achieve functional improvements and patient satisfaction comparable to older cohorts at mid- to long-term follow-up (mean 8.8 years), with relatively low secondary surgery rates [12]. These findings suggest that younger age should not be an absolute contraindication to TAA but rather should prompt enhanced preoperative optimization, patient education regarding realistic expectations, and potentially more stringent patient selection based on socioeconomic factors, compliance capacity, and anatomic suitability.

Age-related outcomes and hospital course

While younger patients experience higher early complication rates, older patients demonstrate different perioperative challenges. The oldest cohorts (>80 years) demonstrate the longest hospital stays (average 2.06 days vs 1.16 days for <50 years, p < 0.001), yet achieve comparable readmission rates, revision rates, and time to return to daily activities as younger patients [13]. Notably, octogenarian TAA patients reported the best postoperative FAAM and SF-12 physical component scores, suggesting that carefully selected older patients may achieve superior functional satisfaction despite longer perioperative recovery times. Preoperative assessment of functional status, physiologic reserve, and living situation should inform discharge planning for older patients, though advanced age alone should not preclude TAA candidacy.

Perioperative risk factors and complications

Obesity and body mass index

The relationship between obesity and TAA outcomes remains complex and incompletely understood. Earlier studies suggested protective or neutral effects of obesity on TAA survivorship, but more recent research has clarified that morbid obesity (BMI ≥35) confers significantly elevated complication risk. In high-risk population studies, morbid obesity was associated with higher rates of any individual complication, total complications, and surgical site infection, though not with increased implant revision rates specifically [14]. A large national database analysis demonstrated that lower BMI was paradoxically associated with increased risk of gutter impingement (OR 0.996, p = 0.02), suggesting that reduced soft tissue padding in lean patients may increase mechanical irritation and symptomatic impingement [15].

Long-term follow-up of obese TAA patients (mean BMI 34.9 kg/m^2) over 14 years demonstrated sustained improvement in pain and disability scores, with 65% of patients requiring no further procedures and overall infection rates comparable to non-obese cohorts [16]. However, 35% of obese patients required additional procedures including gutter debridement (11.9%), ligament repair

or osteotomy (8.3%), and polyethylene exchange (6.5%). Weight-loss counseling and optimization prior to surgery should be considered in obese candidates, though obesity alone should not be an absolute contraindication to TAA.

Smoking and substance use

Tobacco smoking emerged as a consistent risk factor for multiple adverse outcomes following TAA. Active smokers at the time of surgery had significantly higher rates of intraoperative or postoperative bleeding (OR = 5.309), readmission (OR = 1.149), and adverse discharge outcomes (OR = 1.067), with overall increased healthcare costs exceeding $400 per admission [17]. Smoking was also associated with smaller improvements in postoperative functional outcome measures, including reduced gains in AOFAS hindfoot score and physical component summary scores [18].

Non-tobacco nicotine dependence (vaping) has emerged as an additional concern, with propensity-matched analysis demonstrating that vaping users experienced significantly elevated 90-day rates of emergency department visits (RR 1.31), postoperative infections (RR 1.61), and wound complications (RR 1.68), in addition to longer-term complications including pseudarthrosis, mechanical implant failure, and periprosthetic fractures [19]. Preoperative tobacco and nicotine cessation programs should be systematically implemented, with evidence suggesting that cessation at least 2-4 weeks prior to elective surgery may reduce perioperative complications.

Mental health comorbidities and depression

The impact of psychiatric comorbidities on TAA outcomes has received increasing attention, with emerging evidence demonstrating significant associations between preoperative depression and worse postoperative pain, functional recovery, and complications. Systematic review of six studies involving approximately 9,000 patients demonstrated that preoperative depression was associated with worse postoperative pain scores, reduced functional improvement, higher rates of adverse events including prolonged hospital stay and implant subsidence, and greater infection risk [20].

Patients with any mental health disorder demonstrated 16% increased odds of postoperative complications (OR = 1.158, $p = 0.004$), 70% increased odds of adverse discharge (OR = 1.678, $p < 0.001$), 50% increased odds of extended hospital stay (OR = 1.497, $p < 0.001$), and 65% increased odds of infection (OR = 1.654, $p < 0.001$) [21]. Specific mental health diagnoses demonstrated differential risk profiles, with anxiety, psychosis, and post-traumatic stress disorder showing elevated infection risk, while depression and anxiety were associated with higher overall complication rates. Preoperative identification and treatment of depression through standardized screening instruments (e.g., Patient Health Questionnaire-9) and referral for psychiatric optimization represents an important component of comprehensive preoperative preparation.

Operative time and surgical complexity

Longer operative time (≥150 minutes) independently predicted prolonged hospital stay (≥2 days) with more than doubled odds (OR 2.157, $p < 0.0001$), though operative duration did not significantly increase 30-day medical complications, readmissions, or adverse discharge [22]. Concomitant adjunctive procedures at the time of primary TAA were associated with increased operative time and hospital length of stay but did not significantly increase major complication or reoperation risk compared to isolated TAA [23]. These findings suggest that careful surgical planning and implant selection to minimize operative time, along with perioperative optimization protocols for high-complexity cases, may facilitate earlier discharge and reduce hospital-associated morbidity.

Cardiovascular and renal comorbidities

Chronic kidney disease

Chronic kidney disease (CKD) severity significantly impacts postoperative outcomes following TAA. Among 1,678 eligible primary TAA cases analyzed from the NSQIP database, CKD stages G3b and advanced stages G4-G5 were associated with significantly longer hospital stays compared to normal renal function [24]. Multivariable analysis identified CKD stage G3b as a predictor of longer hospital stay, and CKD stages G4-G5 significantly predicted unplanned return to surgery. Smokers with concurrent CKD showed higher overall complication rates. Preoperative assessment of renal function through glomerular filtration rate calculation and perioperative fluid management with consideration of nephrotoxic medications represent important optimization strategies for CKD patients.

Congestive heart failure and cardiac disease

Congestive heart failure, elevated American Society of Anesthesiologists (ASA) classification, and other significant

cardiac comorbidities increase perioperative risk. ASA class 4 status independently predicted increased risk of any adverse event (OR = 1.091, p = 0.04), while congestive heart failure predicted 30-day readmission (OR = 1.281) [25]. Preoperative cardiac risk stratification using validated tools (e.g., Revised Cardiac Risk Index) and collaboration with cardiology for medical optimization may mitigate perioperative cardiac complications in this high-risk population.

Preoperative optimization strategies

Comprehensive risk stratification and patient selection

Effective risk stratification represents the foundation of TAA optimization, enabling surgeons to identify high-risk patients, tailor perioperative protocols, and establish appropriate patient expectations. The development of point-based risk scoring systems incorporating tobacco abuse, age ≥65 years, diabetes, hypertension, elevated creatinine (>1.3 mg/dL), hypoalbuminemia (<3.5 g/dL), COPD, congestive heart failure, hyponatremia, and anemia has demonstrated utility in predicting postoperative complications [26]. In this scoring system, patients were stratified into low (0-20 points), medium (21-30 points), and high (≥31 points) risk categories, with medium-risk patients experiencing 4.7-fold increased odds of postoperative complications and high-risk patients experiencing 8.3-fold increased odds.

Glycemic control and metabolic optimization

Implementation of structured preoperative optimization protocols targeting modifiable metabolic factors has demonstrated effectiveness in reducing surgical site infections and improving overall outcomes. Preoperative optimization including weight management, glycemic control targeting HbA1c <7%, nutritional assessment and supplementation, vitamin D optimization, and enhanced patient engagement was associated with lower odds of superficial surgical site infection compared to conventional preoperative preparation (OR 0.64, 95% CI 0.42-0.97) [27]. Perioperative glucose management with target glucose levels of 100-180 mg/dL represents evidence-based practice, with both hyperglycemia and hypoglycemia associated with increased infection and complication risk.

Nutritional status and albumin assessment

Preoperative serum albumin levels and overall nutritional status warrant assessment, as hypoalbuminemia reflects inadequate protein stores and may indicate compromised immune function. While one single-center analysis found that hypoalbuminemia was not independently associated with 30-day complications following TAA [28], broader orthopedic literature consistently demonstrates that albumin <3.5 g/dL correlates with increased wound complications, prolonged hospitalization, and worse functional outcomes. Nutritional optimization including protein supplementation, vitamin and micronutrient repletion, and dietitian involvement may improve perioperative outcomes.

Infection risk reduction protocols

Comprehensive evidence-based recommendations for SSI/PJI prevention in TAA include preoperative skin cleansing, immune-modulating comorbidity management, BMI optimization, smoking cessation, weight-based and timely antibiotic prophylaxis, optimal preparation of the surgical site with alcohol-containing antiseptics, and reduction of operating room traffic [29]. Consideration of extended antibiotic prophylaxis in high-risk patients with multiple risk factors for infection may be warranted, though current evidence is limited. Minimally invasive surgical approaches and contemporary operative techniques using patient-specific instrumentation have demonstrated potential to reduce operative time and wound complications [30].

Psychosocial preparation and mental health screening

Systematic preoperative screening for depression, anxiety, and other psychiatric conditions using validated instruments such as the Patient Health Questionnaire-9 (PHQ-9) or Generalized Anxiety Disorder-7 (GAD-7) should be incorporated into preoperative assessment, with psychiatric referral for optimization in identified cases. Patient education programs addressing realistic expectations, rehabilitation requirements, activity restrictions, and timeline to functional improvement appear to enhance patient satisfaction and outcomes. Enhanced patient engagement through shared decision-making models and clear communication of individualized risk profiles may improve adherence to perioperative protocols and postoperative rehabilitation.

Implant selection and technical optimization

Fourth-generation TAA implants with minimal bone resection, improved fixation designs, and anatomically refined geometries have demonstrated superior survival rates compared to earlier generations. In a comprehensive historical analysis, first-

generation implants demonstrated only 21% satisfactory outcomes at 5.5 years, while second-generation systems achieved up to 92% survivorship at 12 years, and fourth-generation implants report 1-2 year survivorship between 92-98% [31]. Fixed-bearing cementless designs have emerged as the current standard of care, with stemmed or keeled tibial components demonstrating protective effects against early mechanical failure compared to low-profile implants [32].

Contemporary evidence demonstrates that implant choice may significantly influence failure risk in high-risk populations. Patients with hindfoot arthrodesis demonstrate 2.7-fold increased odds of mechanical failure, with implants featuring more extensive tibial fixation (stems or keels) reducing odds of tibial failure by 95% [32]. Similarly, every 10 kg increase in body weight increases odds of tibial-sided failure by 1.29-fold, suggesting that stemmed implant selection may be particularly beneficial for heavier patients or those with poor bone quality [32].

Long-term survivorship and functional outcomes

Survivorship by implant generation and duration

Large national registry data from England involving 10,335 TAA procedures demonstrated 5-year survival rates of 93.9%, 10-year survival of 89.8%, and 20-year survival of 86.45%, with substantially lower revision rates compared to ankle fusion (0.12 relative risk at 5, 10, and 20 years) [33]. However, cumulative revision burden increased over time, with 28.9% of TAA patients requiring further operation by 25 years, predominantly for exploration/debridement (60%), infection management, or aspiration procedures. These findings underscore the importance of long-term surveillance and proactive management of implant-related complications.

Meta-analysis of six studies with minimum 10-year follow-up in 277 TAA patients demonstrated sustained patient-reported outcome improvements with survivorship ranging from 66-94.4%, though with considerable heterogeneity related to implant design, patient selection, and surgical technique [34]. Average time to implant failure ranged from 54.7-166 months, with failures primarily attributable to aseptic loosening, polyethylene wear, and septic complications. The observed heterogeneity in long-term outcomes highlights the importance of contemporary implant selection and technique refinement.

Functional outcomes and quality of life

Systematic reviews consistently demonstrate that TAA results in significant and sustained improvements in pain, functional capacity, and quality of life measures. Patients show marked improvements in validated outcome instruments including the AOFAS hindfoot score (averaging improvement of ~40 points), Foot and Ankle Outcome Score (averaging improvement of ~40 points), and Short Form-36 physical component scores (averaging improvement of ~10 points). These functional gains are maintained through 10-year follow-up in most studies, though some evidence suggests that mental health component scores may decline in certain populations including morbidly obese patients [16].

Greater postoperative activity engagement correlates with superior functional outcomes, with patients who increase activity levels postoperatively demonstrating significantly greater improvements in ankle-specific outcome measures (MOXFQ) compared to those who decrease activity (-61.6 vs -38.3 points, $p < 0.01$) [35]. This finding emphasizes the importance of rehabilitation protocols and activity encouragement in the postoperative period to optimize functional recovery.

Special populations and risk modification

Rheumatoid arthritis and inflammatory conditions

Patients with rheumatoid arthritis represent a distinct population with specific considerations for TAA. Single-institution series of RA patients undergoing TAA demonstrated excellent prosthesis survivorship (97.4% at 5 years and 74.7% at 10 years revision-free survivorship) with favorable functional outcomes comparable to osteoarthritis cohorts [36]. Notably, disease-specific factors were not significantly associated with revision surgery in RA patients. However, RA patients demonstrated the highest rates of heterotopic ossification postoperatively (3.5% vs minimal in OA cohorts) and reported significantly worse postoperative functional scores despite substantial improvement from baseline [37]. Careful perioperative immunosuppression management in coordination with rheumatology is essential for RA patients undergoing TAA.

High-risk populations and comorbidity burden

Patients with substantially elevated comorbidity burden, assessed through instruments such as the Charlson Comorbidity Index or Elixhauser Comorbidity Index, warrant particular scrutiny during patient selection. However, comorbidity burden alone

should not absolutely preclude TAA candidacy. In comparative analysis of 246 ankle surgery patients, those undergoing TAA were significantly older and had more preoperative comorbidities (5.74 vs 4.74, p = 0.008) than those undergoing arthrodesis, yet experienced lower overall postoperative complication rates (14.71% vs 19.09%) [23]. Osteoporosis and coagulopathies were specifically identified as predisposing TAA patients to postoperative complications, warranting enhanced surveillance and perioperative management in these populations [23].

Social determinants and disparities

Racial and socioeconomic disparities have been identified in TAA utilization and outcomes. Black and Hispanic patients undergoing TAA were statistically significantly younger, more likely from lower income quartiles, had higher comorbidity burdens, and experienced significantly increased risk of extended hospital stays (OR 1.947 for Black, OR 2.054 for Hispanic), adverse discharge to facility, and any complication [38]. Private insurance status and treatment at urban teaching hospitals were independently associated with increased likelihood of TAA utilization compared to arthrodesis [39]. These disparities likely reflect complex factors including differential access to specialized surgical expertise, health literacy differences, and potential bias in provider recommendations. Targeted approaches to improve equitable access to TAA and perioperative optimization in underrepresented populations may reduce unnecessary disparities in outcomes.

Conclusion

Comprehensive preoperative risk stratification in TAA candidates should incorporate assessment of major comorbidities (chronic pulmonary disease, diabetes with glycemic control assessment, peripheral vascular disease), age-related factors, socioeconomic and psychosocial status, functional demands and lifestyle factors, and anatomic suitability based on preoperative imaging. High-risk patients should be identified and offered enhanced preoperative optimization including glycemic control (target HbA1c <7%), nutritional assessment and optimization, smoking/nicotine cessation programs, mental health screening and intervention, physiotherapy consultation, and clear patient education regarding realistic expectations and potential complications.

The evidence presented in this comprehensive review demonstrates that TAA outcomes are substantially influenced by

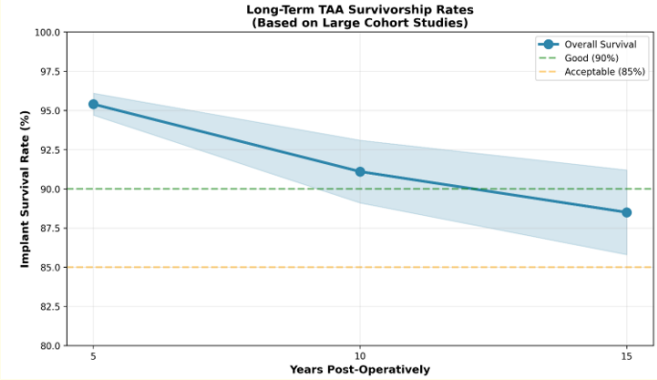

Figure 1: Long-Term TAA Survivorship Rates. Data synthesized from multiple large population-based cohort studies demonstrates 5-year survival rates of approximately 95% and 10-year survival rates of 91%, with gradual decline to approximately 89% at 15-year follow-up. These survival rates represent outcomes across diverse patient populations and implant designs.

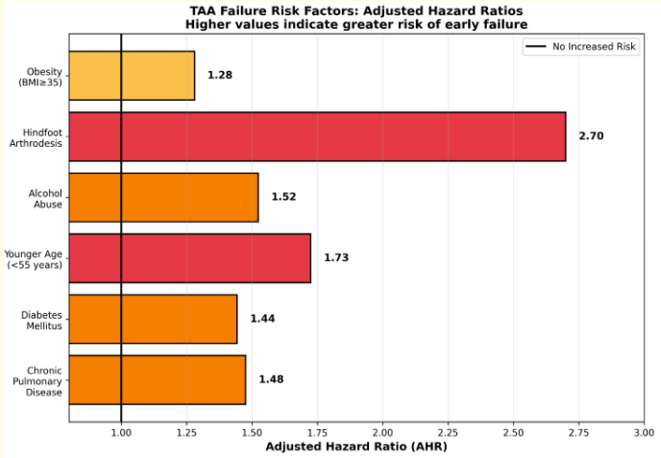

Figure 2: TAA Failure Risk Factors with Adjusted Hazard Ratios. Major risk factors for early TAA failure include chronic pulmonary disease (AHR 1.476), diabetes mellitus (AHR 1.443), younger age <55 years (AHR 1.725), alcohol abuse (AHR 1.524), hindfoot arthrodesis (AHR 2.7), and obesity BMI≥35. These adjusted hazard ratios represent independent risk associations after controlling for confounding variables.

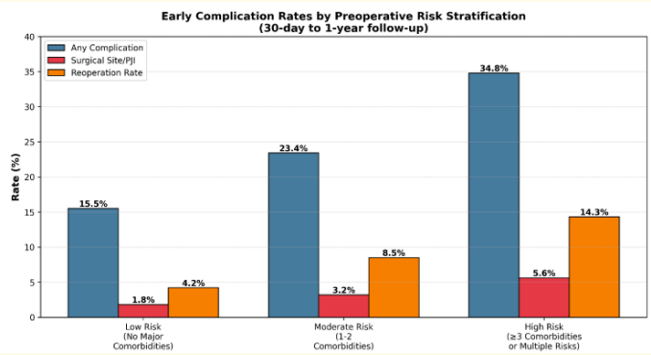

Figure 3: Early Complication Rates by Preoperative Risk Stratification. Risk stratification into low-, moderate-, and high-risk groups demonstrates progressive increases in any complication rates (15.5% to 34.8%), surgical site infection/PJI (1.8% to 5.6%), and reoperation requirements (4.2% to 14.3%). These data support the utility of preoperative risk stratification for patient counseling and perioperative planning.

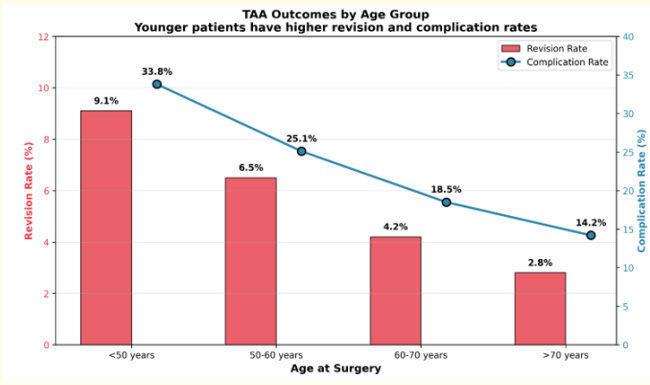

Figure 4: TAA Outcomes by Age Group. Younger patients (<50 years) demonstrate higher revision rates (9.1%) and higher complication rates (33.8%) compared to older age groups, despite generally better physiologic reserve. This age-related complication pattern emphasizes the importance of enhanced patient selection and perioperative optimization in younger candidates.

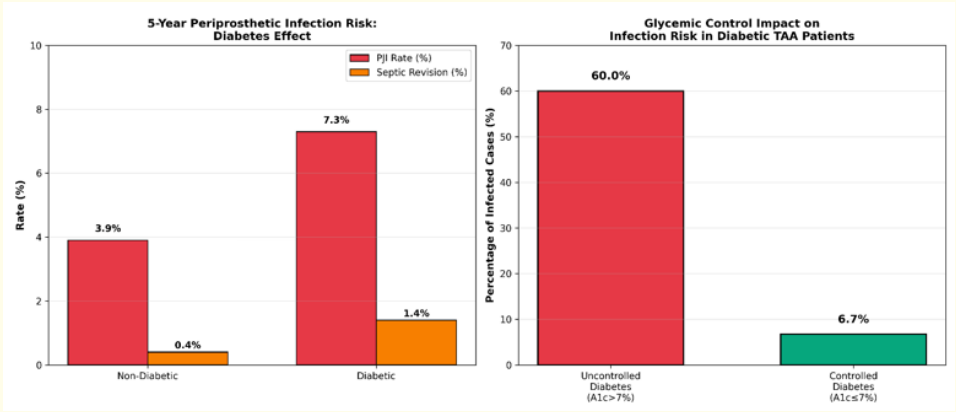

Figure 5: Diabetes and Infection Risk in TAA. Diabetic patients demonstrate elevated periprosthetic infection rates (7.3% vs 3.9% in non-diabetic patients), with more pronounced differences in patients with uncontrolled diabetes (HbA1c >7%). Glycemic control optimization emerges as a critical modifiable risk factor for infection prevention.

modifiable and non-modifiable patient factors that can be identified through systematic preoperative assessment. Contemporary large-cohort studies and registry data provide robust evidence that major comorbidities—particularly chronic pulmonary disease, inadequately controlled diabetes, and peripheral vascular disease—independently increase early failure risk. However, these risk factors should not serve as absolute contraindications but rather should prompt enhanced patient selection, preoperative optimization, implant selection tailoring, and realistic expectation setting.

In appropriately selected and optimized patients, TAA offers durable pain relief and functional improvement comparable to hip and knee arthroplasty, with 10-year survivorship exceeding 90%

and sustained quality-of-life benefits. As TAA utilization continues to expand, systematic risk stratification and evidence-based perioperative optimization protocols represent the most effective strategies to maximize patient selection precision, minimize early complications, and achieve optimal long-term functional outcomes across diverse patient populations.

Conflict of Interest

The author declares no financial interest or conflict of interest.

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