



Is Total Ankle Effective Than

Yes. With advances in the design of newer generation ankle implants, an improved understanding of the biomechanics involved with this procedure and a reduced risk of long-term complications, this author says total ankle replacement is increasingly becoming the procedure of choice for properly selected patients with end-stage arthritis.

By Lawrence A. DiDomenico, DPM, FACFAS

It is estimated that each year approximately 2 million Americans visit physicians for ankle pain stemming from arthritis or post-traumatic injuries. It is estimated that approximately 50,000 people a year are diagnosed with end-stage ankle arthritis, in which the articular surface has worn away, leading to pain and some level of disability, according to industry statistics.

This year in the United States, the use of total ankle joints is expected to increase. According to industry estimates, over 4,000 patients are anticipated to undergo surgical treatment this year for ankle joint replacement.

Presently there are five FDA-approved ankle implants in the U.S. Four of these implants are commonly used in the U.S. and there are over 30 ankle implants currently being utilized in Europe. The demand for total ankle replacement in the U.S. is projected to grow as more and more baby boomers age with debilitating ankle pain.

The ideal patient for ankle joint replacement is someone who is older (preferably around retirement age), thin, active and with low physical demands. Today, the efficacy of total ankle replacement in comparison with that of ankle fusion continues to be one of the most debated topics in foot and ankle surgery.¹

Key Insights On The Evolution Of Total Ankle Replacements

Ankle replacement was first introduced to the U.S. in the 1970s. In the past, total ankle replacements had an unfortunate history stemming from poor mechanical designs and the operating physicians had limited experience. At that time, early reports on total ankle replacements appeared to be promising.²

However, shortly after these reports, long-term follow-up studies highlighted many failures and poor survivorship of the implants. This led many surgeons to abandon the procedure in favor of arthrodesis as it has now become very dependable with limited complications.³⁻⁵

There are a couple of things to bear in mind with the early history of total ankle replacement. In the 1970s and 1980s, many of the surgeons implanting total ankles in the early years were not foot and ankle surgeons. Balancing the biomechanics of the foot and ankle was not well understood or consistently done.

The poor performance of these older ankle implant designs and a lack of understanding of the biomechanics, coupled with use by general (non-specialist) surgeons, resulted in a negative stigma. This consequently made ankle fusion the treatment of choice.

Indeed, problems with early implants left surgeons and patients cautious. Until recently, this patient population had limited surgical options: ankle arthroscopy, ankle arthrodiastasis and ankle fusion for end-stage arthritis.

Ankle fusion typically relieves pain but these patients lose mobility in the ankle. This leads to changes in gait and, ultimately, additional wear and tear causing arthritic pain in other areas of the local anatomy. In 2009, approximately 25,000 people out of 50,000 potential candidates underwent ankle fusions.

However, with an improved understanding of biomechanics and surgeons learning from previous implant failures and successes, total ankle replacement is becoming the procedure of choice for certain patients with end-stage arthritis. The new generation of ankle implants has an improved anatomical design and there is a better understanding for the need to balance the foot and ankle.

In addition, the surgeons implanting these ankle replacements are foot and ankle surgeons. Accordingly, the implants are becoming an increasingly more popular and successful alternative to ankle fusion.

What About Long-Term Complications?

Ankle arthrodesis remains a steadfast surgical procedure of choice for end-stage

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Replacement More Ankle Arthrodesis?

No. While ankle arthroplasty may have a role in treating ankle arthritis in the aging population, this author says ankle arthrodesis is a more proven procedure with a shorter learning curve and better long-term results.

By Craig A. Camasta, DPM, FACFAS

Surgical fusion of the ankle joint is a time-honored procedure that can successfully treat a variety of conditions including arthritis (osteoarthritis, traumatic, rheumatoid, septic, neuropathic), joint instability, contractures and weakness. In treating any joint in the body, one should avoid performing a fusion when possible if a reasonable alternative exists. The ankle is no exception.

Patients who are contemplating an ankle fusion surgery have a generally debilitating deformity with pain that restricts activities of daily living and interferes with engaging in gainful employment. Some patients are unable to bear weight at all due to malalignment or contractures that preclude the ability to wear a shoe.

More severe is the patient with neuropathic osteoarthropathy, which involves the ankle joint. The loss of bony integrity leads to gross instability and exposure of prominent malleoli, which can lead to ulceration and osteomyelitis. For these patients, the choice of an ankle fusion surgery is an easy decision and often their last option before amputation.

However, more common is the patient who has gradual degeneration of the ankle joint secondary to trauma, osteoarthritis or rheumatoid arthritis. This is compounded by obesity, poor bone quality, advanced age or youth. The choice may still be an arthrodesis procedure. Improved quality of

life and the ability to restore pain-free ambulation are expected outcomes for patients contemplating and needing an ankle arthrodesis. For this reason, this procedure will never be abandoned wholesale in favor of joint replacement surgery.

The advent of joint replacement surgery has provided an alternative to fusion and is generally successful in treating the hip and knee. Total ankle joint replacement devices have gone through an evolution that began more than 30 years ago and continues today.

Newer devices have addressed the concerns over the quantity of bone that one removes (less appears to be better). Newer devices have also addressed constrained/cemented design versus mobile-bearing modular designs. Motion between the metallic components through the polyethylene component appears to be more favorable. Implant surfacing can encourage bony ingrowth. However, one fact remains a constant concern regarding any joint replacement surgery. Given enough time, any total ankle joint replacement implant can fail.

Weighing The Merits Of Ankle Arthrodesis

Most long-term studies regarding the outcome of ankle fusion patients look at 10- to 20-year follow-up results whereas few ankle implant studies assess the

patients past two to five years. Long-term assessments of patients who have undergone ankle fusion focus on the impact of the ankle fusion on adjacent joints. As one may expect, there will be increased demands on these joints, which can lead to progressive arthritis. The subtalar joint and, to a lesser degree, the midtarsal joints will undergo degenerative changes that may necessitate additional fusion surgery.

However, what these reports seldom mention is the fact that patients often experience a significant period of time with few symptoms and that it may take many years to manifest pain in the adjacent joints. In addition, if and when additional surgery is required, performing a subtalar joint arthrodesis (or triple arthrodesis) below an already successful ankle fusion is a predictable recovery that may again render the patient pain-free for another extended period of time. The long-term impact of a successful ankle arthrodesis on quality of life is rarely the focus of outcome studies.

It is difficult to compare how a patient would have done without treatment versus having had an ankle fusion based on the number of years of increased activity (ability to exercise, perform activities of daily living and maintain employment) and the overall well-being of a patient. The ability to maintain or improve cardiovascular health, weight management and bone

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arthritis. The short-term outcomes of ankle arthrodesis are vastly improved, particularly with nonunion rates because of improved internal fixation and better surgical techniques. Most reports suggest the average time to fusion is approximately 10.5 weeks, the average fusion rate is almost 93 percent and patient satisfaction rates are almost 90 percent.⁶

However, the long-term complications are quite significant.⁷ At 10 years following ankle arthrodesis, 30 percent of patients in one study had a major complication, 51 percent experienced continued hindfoot pain and 66 percent experienced joint degeneration.

At 15 to 20 years after the procedure, 95 percent of the patients experienced adjacent joint arthritis and a need for arthrodesis at those joints.⁷ Sixty-one percent of the arthrodesis patients had a post-surgical complication with two-thirds having a moderate to severe handicap. These patients also have difficulties with hill and stair climbing coupled with significant emotional and pain-related deficits.

An advantage of total ankle arthroplasty is that it not only relieves pain but also maintains motion. Ankle arthrodesis can relieve pain but sacrifices motion. When patients lose motion, the long-term results with ankle arthrodesis appear unfavorable. These results include a prolonged recovery, lifelong gait changes and overload of adjacent joints. This loss of ankle joint motion leads to abnormal gait patterns and causes restrictions on patients' daily activities.⁸

On the other hand, a successful ankle replacement provides a near normal gait pattern in terms of kinetics of the knee, ankle and tarsal joints.⁹

When comparing total ankle replacement to ankle arthrodesis, total ankle replacement provides movement at the ankle and allows for symmetrical timing of gait and restorative ground reaction force patterns (although oftentimes a slower gait). Ankle fusion in the younger patient frequently progresses to a pantalar fusion with increased limitations and morbidity.¹⁰

The goals of total ankle replacement are to provide limited mobility, reduce pain, restore alignment and replace flex-

With the aging population, the increase in life expectancy and the older generation of patients staying more active, ankle replacement surgery can provide a predictable outcome.

ion and extension movement in the ankle joint. The big concerns about ankle replacement are how often the ankles last, how often they fail and how often they loosen. Complications can include wound healing issues and infection. Severe complications are rare but they can result in amputation.

As more and more implants develop, and more physicians are gaining experience, the rate of complication is decreasing. Many of the newer designs require less bone removal, allowing for the bone implant interface to bond better and prevent subsidence. In addition, the instrumentation is vastly improved to guide surgeons in aligning the implants appropriately.

Although the different FDA-approved devices have many differences and similarities, most differences are between the two-piece and three-piece designs. The choice of implant matters but it is far less important than the experience of the surgeon. The procedure is among the most technically demanding and complex procedures that foot and ankle surgeons perform. One of the major challenges is getting proper position of the foot and ankle so the replacement joint is well aligned.

What The Literature Reveals

As the use of total ankle replacement continues to grow, there is more literature to support the increasing trend of ankle implants for the patient who meets the appropriate criteria.

Knech and colleagues reported on a nine-year follow-up of patients with an

average age of 61.¹¹ Eighty-three percent of the patients reported a functional improvement and 73 percent reported occasional pain or no pain at all. The average range of motion was 18 degrees.

Morrey and other authors have reported on complications of ankle arthrodesis. Less than 25 percent of total ankle replacement patients had progressive hindfoot arthritis at an average follow-up of 7.2 years. Of the patients who had undergone an ankle arthrodesis procedure, more than 50 percent had progressive hindfoot arthritis at an average of eight years and 100 percent had progressive hindfoot arthritis at 20 years.¹²⁻¹⁵

Researchers have concluded that ankle arthrodesis is an excellent option for pain relief but sacrifices motion, placing a great deal of stress on the knee and other foot joints.^{16,17}

A meta-analysis of new generation mobile bearing implants showed that the five-year prosthesis survival rate was 90.6 percent.¹⁸

Haddad and colleagues conducted a review of 49 studies.¹ Ten of these studies reviewed total ankle replacement in 852 patients and 39 studies reviewed ankle arthrodesis in 1,262 patients. The mean AOFAS ankle/hindfoot scale score was 78.2 points for the patients treated with total ankle arthroplasty and 75.6 for patients treated with arthrodesis.

Thirty-eight percent of patients treated with total ankle arthroplasty had an excellent result, 30.5 percent had a good result, 5.5 percent had a fair result and 24 percent had a poor result.¹ In the



arthrodesis group, 31 percent had excellent results, 37 percent had good results, 13 percent had fair results and 13 percent had poor results.

Total ankle arthroplasty revealed a five-year survival rate of 78 percent and a 10-year survival rate of 77 percent.¹ The revision rate for total ankle replacement was 7 percent and the revision rate for ankle arthrodesis was 9 percent with the main reason being nonunion. Surprisingly, the below-knee amputation rate with total ankle arthroplasty was 1 percent and the below-knee amputation rate for ankle arthrodesis was 5 percent.

In Conclusion

Ankle replacement surgery is progressing toward a standard treatment for end-stage ankle arthritis in those patients who meet the appropriate criteria. With the aging population, the increase in life expectancy and the older generation of patients staying more active, ankle replacement surgery can provide a predictable outcome.

Although the literature supports the use of ankle replacement surgery, with all factors considered, there clearly are instances when ankle arthrodesis would certainly be the procedure of choice. The surgeon must take many factors in consideration and look at the entire well being of the patient in order to make the appropriate decision. It is obligatory for the surgeon and the patient to use the utmost discretion in order to choose the proper procedure for each and every case.

Nevertheless, I believe that with clear, specific appropriate indications, ankle joint replacement is superior to ankle arthrodesis. ■

Dr. DiDomenico is affiliated with the Forum Health/Western Reserve Care System in Youngstown, Ohio. He is the Section Chief of Podiatry at St. Elizabeth's Hospital in Youngstown, Ohio. He is the Director of the Reconstructive Rearfoot and Ankle Surgical Fellowship within the Ankle and Foot Care Centers and the Ohio College of Podiatric Medicine. Dr. DiDomenico is a Fellow of the American College of Foot and Ankle Surgeons.

References

- Haddad SL, Coetzee JC, Estok R, Fahrbach K, Banel D, Nalysnyk L. Intermediate and long-term outcomes of total ankle arthroplasty and ankle arthrodesis. *J Bone Joint Surg* 2007; 89(9):1899-1905.
- Tauffer RN. Total joint arthroplasty. The ankle. *Mayo Clin Proc* 1979; 54(9):570-5.
- Bolton-Maggs BG, Sudlow RA, Freeman MA. Total ankle arthroplasty. A long-term review of the London hospital experience. *J Bone Joint Surg Br* 1985; 67(5):785-90.
- Jensen NC, Kroner K. Total ankle joint replacement: a clinical follow up. *Orthopedics* 1992; 15(2):236-9.
- Kitaoka HB, Patzer GL. Clinical results of the Mayo total ankle arthroplasty. *J Bone Joint Surg Am* 1996; 78(11):1658-64.
- Ahmad J, Raikin S. Ankle arthrodesis: the simple and the complex. *Foot Ankle Clin N Am* 2008; 13(3):381-400.
- Fuchs S, Sandmann C, Skwara A, Chylarecki C. Quality of life 20 years after arthrodesis of the ankle. *J Bone Joint Surg Br* 2003; 85(7):994-8.
- Nelissen RGH, Doets HC, Meskers C. The value of ankle prostheses — a gait analysis approach. In: (Kofod H, ed.) *Current Status of Ankle Arthroplasty*, New York, Springer-Verlag, 1998, pp. 72-77.
- Piriou P, Culpán P, Mullins M. Ankle replacement versus ankle arthrodesis. A comparative gait analysis study. *Foot Ankle Int* 2008; 29(1):3-9.
- Rhys TH, Daniels TR. Ankle arthritis: current concepts review *J Bone Joint Surg Am* 2003; 85A:923-936.
- Knecht SI, Snestin M, Callaghan JJ, Zimmerman MB, Alliman KJ, Alvine FG, et al. The Agility Total Ankle Arthroplasty 7 to 16 year follow up. *J Bone Joint Surg Am* 2004; 86-A(6):1161-1171.
- Morrey BF, Wiedeman GP Jr. Complications and long term results of ankle arthrodesis following trauma. *J Bone Joint Surg Am* 1980; 62(5):777-784.
- Said E, Hunka L, Siller TN. Where ankle fusion stands today. *J Bone Joint Surg Br* 1978; 60-B(2):211-214.
- Mazur JN, Schwartz E, Simon SR. Ankle arthrodesis. Long term follow up with gait analysis. *J Bone Surg Am* 1979; 61(7):964-975.
- Coester LM, Saltzman CL, Leupold J, Pontarelli W. Long term results following ankle arthrodesis for posttraumatic arthritis. *J Bone Joint Surg Am* 2001; 83-A(2):219-228.
- Thomas JL, Moeini R, Soileau R. The effects of subtalar contact and pressure following talonavicular and midtarsal joint arthrodesis. *J Foot Ankle Surg* 2000; 39(2):70-88.
- Woodburn J, Udupa JK, Hirsch BE, et al. The geometric architecture of subtalar and midtarsal joints and rheumatoid arthritis based on magnetic resonance imaging. *Arthritis Rheum* 2002; 46(12):3168-3177.
- Stengel D, Bauwens K, Ekkernkamp A, Cramer J. Efficacy of total ankle replacement with meniscal-bearing devices. A systemic review and meta analysis. *Arch Ortho Trauma Surg* 2005; 125(2):109-119.

For further reading, see "Inside Insights On Ankle Replacement Surgery" in the March 2008 issue of Podiatry Today, "A Closer Look At The Future Of Total Ankle Arthroplasty" in the May 2009 issue, "A New Solution For The Arthritic Ankle" in the December 2005 issue, or "Are Ankle Implants Worth Another Look?" in the April 2003 issue.

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density from repetitive stress loading in these patients is of paramount importance and a successful ankle fusion can provide this. In the patient undergoing an ankle fusion as an alternative to amputation (severe contracture, instability, muscle weakness or Charcot deformity), the gains far outweigh the alternative.

Keys To Achieving A Successful Ankle Arthrodesis

The success of an ankle arthrodesis is based on two main factors: successful and timely consolidation, and neutral position of alignment in all three body planes. One can achieve successful consolidation by optimizing the patient's ability to heal. This includes: smoking cessation prior to surgery; adequate calcium and vitamin D levels; and preoperative physical therapy to ensure proper training to be non-weightbearing. There must also be meticulous attention to technical detail at the time of surgery.

As with any fusion surgery, surface preparation must include removal of all cartilage and subchondral bone to expose healthy, bleeding, cancellous bone while maintaining maximum bone-to-bone contact between the opposing surfaces. One can preserve length by maintaining the contour of the bone surfaces (curettage, drilling, burring) rather than performing saw/tabletop resection of the joint. Finally, the choice of fixation (including crossed-screw fixation, plating, intramedullary nailing and external fixation) should match the individual needs of the patient.

With regard to the ideal position of fusion, it is well accepted that the ankle should be aligned with the foot 90 degrees to the leg (neither plantarflexed or dorsiflexed). One should be sure to position the ankle so the subtalar joint is in a neutral position with the ability to supinate and pronate independent of the ankle. Surgeons should avoid fusing the ankle in plantarflexion to accommodate shoe heel elevation since this will force the foot to pronate to its end range of motion whenever the patient is not shod. When it comes to patients with a tight heel cord (equinus), it is possible to inadvertently pronate the

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foot through the subtalar joint in an attempt to dorsiflex the ankle.

Intraoperative radiographic assessment should confirm that the lateral talar process has not shifted forward against the floor of the sinus tarsi prior to finalizing position and fixation of the ankle. Proper neutral positioning of an ankle fusion can prolong the development of adjacent joint arthritis.

Essential Factors To Consider In Choosing Between The Two Procedures

Deciding between an ankle implant or ankle arthrodesis comes down to a simple relationship between two factors: pressure and time. If there is abundant pressure and lots of time, bony subsidence (aseptic loosening) can occur in the implant patients and this usually occurs on the smaller bone surface, the talus.

Then things get interesting. Revision surgery leaves two options: implant a new device (which requires the removal of more bone and further shortening of the limb) or fuse the ankle with bone graft interposed at the fusion site to restore length. The latter is more complicated than a first-time ankle fusion (morbidity of bone graft donor site, increased risk of nonunion, longer time to consolidate).

Ankle implants generally do well in sedentary, older, non-obese patients with adequate bone stock and no evidence of active infection. The patients must have no significant angular deformity, no proximate distal areas of arthritis and no neuropathy. When one stringently follows the

exclusion criteria, this eliminates many people who need ankle surgery.

A Closer Look At The Comparative Literature

Comparison of outcomes between ankle implant and ankle arthrodesis patients reveals a few interesting findings. In the short term (reviewed at 24 months), there is no difference in pain reduction between the two groups.¹ Most patients (85 percent) with either procedure experienced significant reduction in pain and improvement in functional capacity in comparison to before their surgery.

SooHoo and colleagues compared ankle joint replacement and ankle arthrodesis patients.² As the authors noted, "the rates of major revision surgery after ankle replacement were 9 percent at one year and 23 percent at five years, compared with 5 and 11 percent following ankle arthrodesis." Conversely, in the same study, patients undergoing ankle fusion surgery had a higher rate of requiring a subtalar joint fusion (2.8 percent) in comparison with the ankle implant patients (0.7 percent).

Another study reported on 306 primary ankle arthroplasties with follow-up for an average of less than three years.³ The study authors noted that 28 percent (85 patients) underwent 127 revisional operations (168 procedures).³ Most studies reporting on outcomes of ankle arthroplasty confirm an alarming learning curve for the surgeon that directly relates to complications and the need for revisional surgery.

Saltzman and colleagues reported that ankle replacement patients in the first part



Counter Point

of their study (158 patents) experienced a higher rate of complications than the comparative group of patients who underwent an ankle arthrodesis.¹ These complications included intraoperative malleolar fracture, nerve injury, edema, decreased range of motion (ROM) and wound problems. In their continued study looking at the next 448 patients who underwent ankle replacement, the rate of secondary surgical procedures decreased by 50 percent as did the overall rate of perioperative complications and adverse events.

It is particularly evident with total ankle arthroplasty that the experience of the surgeon is an important factor in success and avoiding complications. One should question whether the general orthopedic/podiatric community can replicate data obtained by a small group of elite surgeons.

A comparison of gait analysis following both procedures produced interesting but not unexpected findings. One study showed that ankle arthrodesis "resulted in a faster gait with a longer step length compared with (ankle) replacement,

although the timing of gait demonstrated greater asymmetry."⁴ As one would expect, the ankle replacement group had greater movement of the ankle while neither group of patients restored normal movement or walking speed in comparison with the healthy control group.

No other studies have directly compared the two procedures for gait quality or return to recreational/sporting activities. However, several authors have demonstrated decreased cadence, stride length, gait velocities and hindfoot and midfoot motion in ankle arthrodesis patients in comparison with control groups.⁵

There are conflicting reports regarding overall outcomes in comparing patients who have undergone an ankle implant procedure versus those who have had an ankle arthrodesis procedure.⁶ In comparing cost effectiveness between these two groups, SooHoo and Kominski concluded that ankle arthroplasty was associated with a greater lifetime cost than ankle arthrodesis without an appreciable gain in quality-adjusted life years.⁷

ideal candidate, arthroplasty will have a role in treating our aging patient population.

Whether one procedure is better than another comes down to the specific needs of each patient. Both ankle arthrodesis and ankle arthroplasty can provide significant pain relief, improved quality of life and a return to activities.

If patients have an ankle arthrodesis, they will likely develop adjacent joint arthritis in the distant future (10 to 20 years). If they have an ankle arthroplasty, they will more likely require a revisional procedure in the near future (one to three years). As the treating surgeon, your challenge is to guide the patient toward an optimal treatment plan, weighing the balance between your skills and the current body of ever evolving information. ■

Dr. Camasta is in private practice at Village Podiatry Centers in Georgia. He is a Fellow of the American College of Foot and Ankle Surgeons, and a faculty member of the Podiatry Institute.

References

1. Saltzman CL, et al. Prospective controlled trial of STAR total ankle replacement versus ankle fusion: initial results. *Foot Ankle Intl* 2009; 30(7):579-596.
2. SooHoo NF, et al. Comparison of reoperation rates following ankle arthrodesis and total ankle arthroplasty. *J Bone Joint Surg* 2007; 89(10):2143-2149.
3. Spirt AA, Assal M, Hansen ST. Complications and failure after total ankle arthroplasty. *J Bone Joint Surg* 2004; 86-A(6):1172-1178.
4. Piriou P, et al. Ankle replacement versus arthrodesis: a comparative gait analysis study. *Foot Ankle Intl* 2008; 29(1):3-9.
5. Thomas R, Daniels TR, Parker K. Gait analysis and functional outcomes following ankle arthrodesis for isolated arthritis. *J Bone Joint Surg* 2006; 88(3):526-535.
6. Guyer AJ, Richardson EG. Current concepts review: total ankle arthroplasty. *Foot Ankle Intl* 2008; 29(2):256-64.
7. SooHoo NF, Kominski G. Cost-effectiveness analysis of total ankle arthroplasty. *J Bone Joint Surg* 2004; 86-A(11):2446-2455.

For further reading, see "A Closer Look At The Mini-Open Ankle Arthrodesis" in the January 2009 issue of Podiatry Today or "Is Arthrodesis The Answer For A Severely Deformed Ankle?" in the September 2002 issue.

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In Summary

Ankle arthritis will continue to challenge the treating physician. Whether one procedure is superior to another remains within the domain of future studies. There will always be a group of patients who are not candidates for an ankle implant so it is important to keep refining the surgical techniques that achieve successful fusion of the ankle joint (timely consolidation and optimal position). As implant designs improve and the indications more clearly focus on the