Weight-bearing Pressure And Pain Outcomes Are Better In Lower Extremity Amputees Undergoing An Ertl Amputation Vs. A Traditional Amputation

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Disclosures:

Introduction: In the past decade, high energy or blast injuries have contributed to the dramatic increase in the number of amputations performed on military personnel1. Unfortunately, there is significant functional loss and morbidity associated with lower extremity amputations, especially at the transfemoral level. In an effort to improve patient functionality and mitigate potential long-term complications, we are evaluating alternative surgical options. Contrary to standard technique, the Ertl procedure is a reconstructive technique that theoretically re-establishes intramedullary pressure, improves residual limb vascularity2, restores length-tension muscle relationships, limits painful gait mechanics, and improves end-bearing capabilities. However, there is currently a lack of conclusive clinical data as to whether these benefits are realized. To investigate these potential benefits, we measured weight-bearing capacity, pain outcomes, and function/bothersome status in patients receiving either the standard or Ertl procedure. We hypothesize that the Ertl procedure allows for better weight-bearing capacity over their residual limb and less perceived pain. By improving weight-bearing capacity and reducing pain, we believe the Ertl procedure may better facilitate prosthetic use, anatomic gait, increased functionality, and subsequently, a more reliable return to a pre-amputation level activity.

Methods: Our study enrolled 32 patients receiving a standard or Ertl, primary or revision, amputation at either the transfemoral or transtibial level. These patients completed the Short Musculoskeletal Function Assessment Injury and Arthritis Survey (SMFA) and Visual Analogue Scale (VAS) assessments to quantify their function/bothersome status and their pain status, respectively. The patients’ weight-bearing pressures over their residual limb, as well as the surface area of distal residual limb, were measured with the Xsensor® pressure mapping system, recorded in three trials, and subsequently analyzed using a two-sample t-test.

Results: At both transfemoral and transtibial levels, patients receiving the Ertl procedure could significantly bear more average pressure over their residual limb while experiencing significantly less pain (Fig 1.), as compared those receiving the standard procedure. The Ertl procedure yielded larger residual limb surface areas (Fig 2.), as well as trends for better bothersome and function SMFA scores, than the standard procedure. In one case study (Fig 3.), an Ertl amputation revision at the transfemoral level resulted in a 51% increase in weight-bearing pressure, 78% reduction in pain, 57% improvement in function status, and 87% reduction in bothersome status.
Figure 1. Weight-bearing (WB) capacity in transfemoral (blue) or transtibial (red) amputees receiving either the standard or Ertl procedure. (A) Patients receiving the Ertl procedure could significantly bear more average pressure over their residual limb, as compared to those receiving the standard procedure, at both transfemoral and transtibial levels (p=0.05 and p=0.02, respectively). (B) The Ertl procedure results in significantly lower VAS pain scores than the standard procedure at both transfemoral and transtibial levels (p<0.02 and p<0.01, respectively).

Figure 2. Compared to the standard procedure, the Ertl procedure results in larger distal surface areas of the residual limb, which is significant at the transtibial level (p=0.01).
Discussion: The Ertl amputation procedure appears to allow patients to bear more weight comfortably on their residual limb. The increased surface area of the distal limb in the Ertl amputees tended to be larger than that of the standard amputation, which may facilitate patients’ weight-bearing capacity. Indeed, our results illustrate that the Ertl procedure produces significantly larger weight-bearing pressures of the amputated leg, as well as significantly lower VAS pain scores, as compared to the standard procedure. There were also trends for better functional outcomes and lower bothersome status. Thus, patients receiving an Ertl amputation appear to better tolerate weight bearing on their residual limb, which in turn may facilitate prosthetic use, perceived comfort, increased functionality, and a more reliable return to a pre-amputation level of activity.

Significance: Our study was designed to examine surgical technique and functional outcomes in patients undergoing lower-extremity amputation with the hope of learning how surgical technique impacts their post-amputation level of function and activity. Dramatic improvements in function of transfemoral or transtibial amputees may be possible with a change in surgical technique. Our data suggests that such a change can yield a 50% improvement in weight-bearing capabilities and a 55% reduction in perceived pain, which would decrease the work effort of ambulation and therefore improve distance/endurance/strength capabilities of these individuals.

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References:

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