Introduction
Recent studies have shown that extracorporeal shockwave therapy (PACE®/ESWT) can accelerate the healing of diabetic foot ulcers. We hypothesized that this improved healing time may be due to the effects of PACE®/ESWT shockwave therapy on the microvasculature, neovascularization and reduction of endothelial inflammation and this phenomenon’s overall effect on improving perfusion. The aim of the study is to observe the effect of large target area PACE®/ESWT has on the speed of healing incision lines of the primary closed diabetic foot wounds as well as the reduction of postop edema.

Methods
Patients selected for this study were identified from our operative list requiring surgery to correct either a foot deformity, a nonhealing wound as a result of the deformity or diabetic peripheral ischemia and associated distal gangrene. All operative sites were closed primarily. Patients selected, were between the ages of 55 and 69, had type 2 diabetes in variable states of control, with HbA1c’s ranging from 7.6 to 11.2, had lengthy histories of chronic foot wounds or peripheral gangrene that required definitive surgery. All test subjects had peripheral arterial disease as measured by pulse volume recordings (Sensilase; Vasamed) and 14 of the 21 patients had at least one attempt to revascularize, either endovascularly or surgically.

Surgery was performed in an outpatient center under regional block and immediately thereafter a 1000 shock counts with PACE®/ESWT to the protocol, appears to hasten the overall healing affect and allowed the patient is to revascularize, either endovascularly or surgically. Of the 6 remaining patients who did not go on to heal after the 3-treatment protocol, 3 of them healed after 2 subsequent visits and application of PACE®/ESWT, noting that their edema reduction was like those that healed after 3 treatments. The periwound area was assessed visually for edema and the incision line for tissue annealing.

Results
In this observational study we were able to realize how the outcome of PACE®/ESWT effects the healing of primarily closed wound sites. The operations included digit amputations, ray resections and forefoot amputations. Our assessments included rate at which the incision line closed together and the amount of edema postoperatively. We observed that the edema reduced quickly from between 3-4+ postoperatively to negligible amounts after the third PACE®/ESWT treatment. This contrasts with our previous experience with similar operations in which edema and incision line healing dehiscence were intimately linked postoperatively and tended to slow the overall healing after these surgeries. The introduction of PACE®/ESWT shockwave therapy to the protocol, appears to hasten the overall healing affect and allow the patient to return normal weightbearing activities sooner.

Of the 21 patients enrolled in the study, 15 went on to complete healing within the 3-treatment protocol. Of the 6 remaining patients who did not go on to heal after the 3-treatment protocol, 3 of them healed after 2 subsequent visits and application of PACE®/ESWT, noting that their edema reduction was like those that healed after 3 treatments. The remaining 3 had postoperative complications with wound dehiscence unrelated to the shockwave treatment, 1 of those individuals passed away.

Discussion
The use of PACE®/ESWT in the treatment of diabetic wounds has been shown to be effective in accelerating the healing process. Recently, work efforts in other countries and in large-scale human trials with PACE®/ESWT to improve the microvasculature and reduce the amount of edema postoperatively, have focused on large-area PACE®/ESWT to improve the microcirculatory blood flow, reduce the endogenous inflammation. Our hypothesis that this microvascular effect may also be effective in speeding up the anealing of incision lines and as well, the reduction of postoperative edema in primarily closed diabetic foot wounds appears to be supported by our findings in this small cohort of 21 patients. We saw a demonstrable reduction in postoperative edema and an increase in durably healed incision lines after 3 PACE®/ESWT treatments postoperatively. The mechanism how effects this event is still unclear. We have strong rationalizations that stimulation of neovascularization as well as the reduction of microvascular endothelial inflammation have a role in this phenomenon. It is worthwhile that more objective work be done in this regard. Investigators are encouraged to extrapolate on the findings of the previous studies work examining PACE®/ESWT and its effect on accelerating the closure of diabetic wounds and use the data to expand the scope of this promising and exciting new technology.