Supplementary Online Content


eFigure 1. Study protocol schematic
eFigure 2. Clinical photograph of a patient

This supplementary material has been provided by the authors to give readers additional information about their work.
**Supplementary eFigure 1. Study Protocol Schematic**

**Treatment Group 1: 20 minute incubation**
1. All subject randomized for split-face application of microneedle vs. sham pre-treatment for either right or left side of the face
2. Whole face imaging, AK counts and mapping, TEWL measurements
3. Pretreatment with microneedles and sham respective to each randomized side of the face
4. Patient pain assessment on VAS
5. Repeat TEWL measurements on the right and left face

**PDT Treatment**
1. Application of ALA to entire face and incubate for 20 minutes
2. Blue light exposure for up to 1000 seconds (as tolerated by patient)
3. Patient pain assessment on VAS

**Follow up in 1-2 months**
1. Whole face imaging and AK counts and mapping

**Treatment Group 2: 10 minute incubation**
1. All subject randomized for split-face application of microneedle vs. sham pre-treatment for either right or left side of the face
2. Whole face imaging, AK counts and mapping, TEWL measurements
3. Pretreatment with microneedles and sham respective to each randomized side of the face
4. Patient pain assessment on VAS
5. Repeat TEWL measurements on the right and left face

**PDT Treatment**
1. Application of ALA to entire face and incubate for 10 minutes
2. Blue light exposure for up to 1000 seconds (as tolerated by patient)
3. Patient pain assessment on VAS

Abbreviations: AK (actinic keratoses), TEWL (transepidermal water loss), VAS (Visual Analog Scale), ALA (aminolevulinic acid), PDT (photodynamic therapy)
Supplementary Figure 2. Clinical photograph of a patient

Clinical photograph of a patient before (A) and one month after (B) photodynamic therapy (Right: Microneedle side, Left: Sham Side).