Introduction:
Visual reduction in keratoconus (KC) and post-surgical ectasia patients is commonly due to increased higher order aberrations (HOAs). Novel surgical treatment strategies for these irregular corneas include corneal collagen crosslinking (CXL) and/or intrastromal ring segments, which may improve corneal central curvature and consequently reduce HOAs as well as deferring the need for corneal grafts. However, non-surgical rehabilitation traditionally has been the primary visual management method where rigid gas permeable (GP) lens is the standard treatment choice.

The Collaborative Longitudinal Evaluation of Keratoconus (CLEK) study reported a success rate of 65% with GP lenses in its subjects at enrollment. In addition, only 15% of those subjects reported good GP lens comfort in both eyes. Although the association between subjective comfort and general success is expected, CLEK study data further revealed that a 14% greater likelihood of self-reported lens comfort was also found with each additional five letters gained for visual acuity (VA).

Given the significant associations between lens comfort, visual acuity and lens fitting success, many lens designs ranging from specialty soft lenses to scleral lenses have evolved. An example is Clearkone (CK) lens, which is a recent development in hybrid contact lens technology. CK lens is composed of a high DK GP center with a surrounding soft lens skirt. Although earlier generations such as Saturn and Softperm hybrid lenses commonly encountered fitting complications such as decentration, GPC, hypoxic, synechoe, and juxtanodal flare, its modern design in the CK hybrid platform include the incorporation of reverse geometry (Figure 1) and enhanced GP permeability, sagittal vault angles, and juxtanodal adhesion, all of which appear to greatly overcome many of its predecessors' shortcomings.

The newly added CK lens features may enable lens centration and closer corneal alignment by its optical zone, which may further minimize HOAs and thereby improve visual comfort and acuity. However, given the recent release of CK lenses, literature search yields little available data in its uses and clinical outcome in these KC and ectasia patients. It is important to note that CK lens utilization in post-surgically treated KC and ectasia eyes (CXL, Intacs, PKP) are currently under investigation. Since the introduction of CK lenses coincided with start of this investigation, a learning curve effect may need to be investigated to consider possible impact on study findings. Therefore, when the first 20 eyes were excluded as failures in the pre-appraisal learning period (9 post-surgical and 11 non-surgical), the overall success rate was calculated to be 76.2% (99/130) whereas the success rate in stratified post-surgical subgroup was 62.9% (28/45). Greater CK lens success was associated with eyes with higher Pentacam values of K-steep, K-flat, K-max, K-average, and K-center. A further review of disease severity and CK success revealed greater success (p<0.0006). Figure 3 in it is more severe disease grade 3 and 4 compared to milder disease grade 1 and 2. Corneal astigmatism (Pentacam) manifested spherical equivalence and cylinder, was not associated with success rates.

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Methods:
A retrospective chart review of CTC and ectasia patients fitted with CK lenses from May 2009 to August 2011 was performed. All lens fitting was performed by one of the authors (EC). A subset of post-surgical eyes (CXL, Intacs, or PKP) was also analysed. Lens success was defined as those using CK lenses 3-months post final fitting. Relationship of CK lens type and KC severity stage to CK lens success was examined. For each subject, the first successful lens fitting trial was included in analysis.

Results:
Greater CK lens success was associated with eyes with higher Pentacam values of K-steep, K-flat, K-max, K-average, and K-center. A further review of disease severity and CK success revealed greater success (p<0.0006). Figure 3 in it is more severe disease grade 3 and 4 compared to milder disease grade 1 and 2. Corneal astigmatism (Pentacam) manifested spherical equivalence and cylinder, was not associated with success rates.

Conclusions:
Greater CK lens success appears to be associated with more advanced diseases as steep keratometric values and higher stages of severity are associated with more successful outcome. Comfort of CK lenses contributes to success as eyes with no improvement or mild decrease in visual acuity continued with CK lens wear. Overall, CK lens hybrid success rates of 76.2% generally and 82.9% in post-surgical group were found after taking possible learning curve effect into consideration. Hence, CK hybrid lenses appear to be an effective non-surgical option for KC and ectasia eyes.