Aims of the study
To evaluate the feasibility of telescreening for retinopathy of prematurity using a video indirect ophthalmoscope in terms of
1) clarity of images,
2) grading of retinopathy of prematurity
3) concordance among retinal specialists with the primary screening personnel
4) extent of periphery visualized

Materials and methods
10 neonates (<32 weeks at birth or <1500mg birth weight) present in our neonatal intensive care unit during the month of April, 2008 were chosen for the study. The infants were dilated using a 50% dilution of tropicamide (0.8 %) and phenylephrine (5%). The eyes were anesthetized using proparacaine eyedrops. A nonophthalmologist trained in indirect ophthalmoscopy used the video indirect ophthalmoscope to record images of the retinal periphery of both eyes of these infants. The images were transmitted to the telemedicine hub using a bandwidth of 384kbps. 3 ophthalmologists trained in the diagnosis of ROP (hereafter referred as experts) independently viewed the images. The images were graded according to the
1) severity of ROP
2) presence of plus disease
3) extent of periphery seen
4) clarity of images.

Severity of the retinopathy of prematurity
Severity of the disease was graded according to the International classification of retinopathy of prematurity(ICROP) depending on zone involved(Fig1) stage of the disease and number of clock hours involved (Fig 2) and the presence of plus disease.

Extent of periphery
This was graded in each eye according to the extent of retina to the periphery that was clearly visualized. It was classified as
1) periphery seen up to zone3
2) periphery seen only up to zone 2
3) only zone 1 seen

Clarity of images
This was graded on a scale from
1) excellent
2) satisfactory
3) not satisfactory

Excellent- the stage of ROP seen was clearly evident
Satisfactory- the stage of ROP could be diagnosed with difficulty
Not satisfactory- the stage of ROP was not clear

Grading of the ROP in exactly similar manner of all 20 eyes of 10 neonates was also done by another retinal specialist (hereafter referred as primary screening retinal surgeon) on the same day by indirect ophthalmoscopy using the 20D and 28 D lens and scleral indentation.

Degree of concordance between the experts and with the primary screening retinal surgeon was assessed. Video indirect images were obtained in all the neonates screened-grading of the retinopathy of prematurity by the primary screening retinal surgeon was considered as gold standard. The grading by the experts was evaluated against this for sensitivity.

Results
There were 6 male babies and 4 female babies included in the study. The mean age at birth was 30 weeks and mean birth weight was 1200mg.

Of the 20 eyes included in the study,
4 eyes had zone 2 stage 3 disease and of this, one eye had plus disease as well requiring treatment.
6 eyes had avascular retina zone 3 with no retinopathy of prematurity requiring only follow up.
10 eyes had stage 1 and 2 in zones 2 and 3 requiring follow up.
None of the eyes had zone 1 disease or stages 4 or 5.

Gradability of images
All 3 experts graded clarity of 90% of the images as satisfactory and 8% images as excellent. Only 2% images were graded as not satisfactory.

Extent of periphery seen
In 4 eyes, zone 3 was not visualized clearly while in 16 eyes zone 3 was clearly seen. (80%) Zone 2 was clearly seen in all the eyes (100%) as was zone 1 (100%)
Sensitivity in grading stages of ROP
Plus disease—100% for all 3 experts
Stage 3 zone 2-100% for all experts
Stage 2 zone 2-100% for all experts
Stage 1 zone 2-100% for all experts
Stage 2 zone 3-80% for 2 experts and 90% for the third
Stage 1 zone 3-80% for all 3 experts

Sensitivity to pick up the grades of ROP that require treatment-100%

Discussion

With advances in neonatal life support our neonatal ICUs are offering a chance of survival to even the most premature of babies and a lot of these preemies now survive against all odds. However, the paucity of adequately trained retinal surgeons means that a lot of the neonatal ICUs do not have adequate screening personnel for retinopathy of prematurity. The Retcam which is primarily used for imaging the periphery in infants and children is a tool that is quite beyond the reach of many hospitals because of its high cost. Using this as a screening tool will mean investment that would not be practical considering the small part retinopathy of prematurity plays in the practice of an average retinal surgeon. However, the part that retinopathy of prematurity plays in contributing to childhood blindness is considerable (Fig3) and it takes on greater proportions considering the advances in neonatal care.

Telemedicine has been used in various specialities to increase the reach of specialized care to remote places and ophthalmology has not been lagging behind in utilizing its vast potential. In our centre, teleophthalmology has been developed with the help of Direct Relief International and the Indian Space Research Organisation. With a bandwidth of 384 kbps it provides real time transmission of images for viewing in the telemedicine hub inside the hospital premises.

The aim of this study was to demonstrate and develop a low cost, effective screening method that can be used in areas where trained retina specialists are not available.

Most of the studies for tele screening in retinopathy of prematurity have been done using Retcam images [1,2] or other digital wide angle fundus cameras [3,4,5]. While Retcam images are undeniably of superior quality, the prohibitive cost prevents it from being used commonly. The video indirect ophthalmoscope on the other hand is a low cost alternative to the retcam which gives gradable clarity of images as demonstrated in our study. The video indirect ophthalmoscope has been used along with a computer programme called ROP tool to assess vessel tortuosity and thus diagnose plus disease [6]. To train a nonophthalmologist to do the imaging meant that a treating neonatologist can be trained to do the same and telemedicine connectivity ensures that the images are transmitted realtime and management decisions taken by the retina specialist sitting far away. Another easier alternative is that an ophthalmologist without any specialized retina training can very easily capture the images by the videoindirect ophthalmoscope which is also a viable option since we have adequate number of ophthalmologists in our country.

The most important outcome of this study is the sensitivity to pick up grades of retinopathy of prematurity requiring treatment—This was 100% in our study which means that it is a safe tool to be employed as screening facility comparable to studies using the Retcam. The drawback seen in our study was the lower sensitivity to visualize zone 3 which translates to 2 or 3 more follow up visits for the baby to ensure adequate vascularisation of the extreme periphery. However, this is probably acceptable considering the alternative is no screening at all.

Conclusion

The study was intended as pilot study to develop a low cost alternative to Retcam screening for retinopathy of prematurity. The initial results are promising with our study demonstrating 100% sensitivity in picking up treatment warranting grades of ROP which is comparable to other major studies using the Retcam [1]. However, larger studies with more numbers and vertical followup is required before such a model can be used in our society.

References

5. The Photographic Screening for Retinopathy of Prematurity Study (Photo-ROP): study design and baseline characteristics of enrolled patients. Photographic Screening for Retinopathy of Prematurity(Photo-ROP) Cooperative Group, Balasubramanian M, Capone A Jr, HartnettME, Pignatto S, Trese MT Retina. 2006;26(7 Suppl):S4-10
Figure 1

Figure 2

Figure 3

Percentage of Severe Visual Impairment and Blindness in Children in Schools for the Blind in Different Regions due to ROP

<table>
<thead>
<tr>
<th>Region</th>
<th>Lower Limit</th>
<th>Upper Limit</th>
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<tbody>
<tr>
<td>Europe</td>
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Figure 3