

# ARROWS AT EDGE (TONDEL'S ARROWS) PROCEDURES

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## DESCRIPTION:

Arrows at Edge Card (format A4) consist of 6 pairs of colorful arrows. The arrow heads from each pair touch each other along the middle, vertical line of the card. The card has to be folded along this line and shaped into a wedge. The left and right side of the wedge has a set of 6 arrows (one from each pair). Such prepared card, placed in front of the face, allows the right and left eye to see one side of the wedge accordingly. By changing convergence it is possible to see sequentially each pair of arrows touching with the arrow heads. *Only precise and stable alignment of the eyes allows stable perception of each pair of the arrows connected at the arrow heads.* The edge of the wedge is seen similarly to the string in Brock String. The Arrows at Edge card enables training both smooth and jump vergence movements. The card was design by Grazyna Tondel, M.D., M.S., Ph.D. in cooperation with Boleslaw Kedzia, PhD.

## GOALS:

The Arrows at Edge card was design to continue and improve vergence training after initial phase performed with the Brock String.

The initial phase using Brock String should be performed in order to:

- introduce appreciation of converging and diverging
- introduce physiological diplopia awareness

Goals of the training with the Arrows at Edge card:

- convergence training in near distance
- normalization of the near point of convergence

Expected advantages of the card over continuing training with the Brock String and using Barrel Card:

- the Arrows at Edge card provides clear stimulus for accommodation (tips of the each pair of arrow heads) assuring holding accommodation at the right distance
- uses the "natural" desire to connect images from both eyes (arrow heads)
- allows precise training at the near distance
- avoids confusion that may be introduced by the need of perceiving mixing colors (Barrel Card)
- allows training jump and smooth vergence movement between different distances with no need to move fixation targets.
- provides clear suppression cue (pairs of arrows)

## SET UP:

- the provided card need to be precisely folded along 3 dotted line (the middle and two side lines) (Fig. 1. A.)
- the sides of the card need to overlap and should be taped to assure secure position of the shaped wedge (Fig. 1.B.)
- the sides of the wedge should have a curved, not straight, shape. This can be achieved by gentle pushing the wedge from the top (middle line) (Fig.1.C.)
- the wedge should be placed in front of the eyes with the middle line along sagittal plane. This way each eye sees one side of the wedge. The distance from the eyes can vary but with exercise progress the card should touch the tip of the patient nose. (Fig.2.A.)
- the patient need to be sure that each eye can see only one side of the wedge (it can be checked by closing each eye) (Fig. 2.B.)

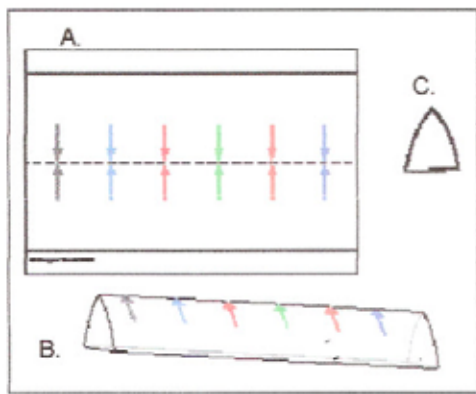


Fig. 1. A. The card with folded lines.  
 B. The card shaped in to a wedge.  
 C. The shape of the wedge

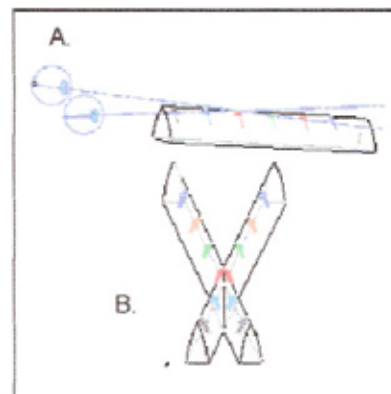


Fig.2. A. The wedge placed in front of the eyes in saggital plane.  
 Each eye sees only one side of the wedge.  
 B. The patient view of the Arrows at Edge.

## GENERAL PROCEDURE

When the patient observes each pair of the arrows s/he need to make sure that arrows precisely and stable touched themselves at the tips of the arrow heads (Fig.2). The arrows should not overlap. The arrow heads should be seen sharply. Such an image must be held each time for few seconds before moving to the next pair. All the time the patient should be aware of diplopia (double image of the edge of the card that crosses at the arrow pairs being fixated). Not observed arrow pairs should not connect, but both elements of the pair should be seen. Initially the patient should change the convergence distance by jumping from one pair of arrows to another (\*), first in order than randomly. Changing the order of the pair provides different amount of convergence change demand. While moving from pair to pair each time patient should observe next pair of arrows for few seconds and be aware of the crossing edge. Next a smooth changing of the convergence distance can be introduced. When traveling from one pair of arrows to another, the patient should observe the movement of the crossing of the edge. During the whole training time the patient should check the alignment of the card by closing each eye from time to time, assuring that each eye sees only one side of the card.

\* The initial way of convergence changing (jumps or smooth) can be altered and may depend on the patient preference (which task is easier).

## POSSIBLE ALTERNATIONS AND/OR ENHANCEMENTS OF THE PROCEDURE

### LENSES AND/OR PRISMS

The card allows introducing additional lenses (e.g. +1.00 D OU or -1.00 D OU) to alter required accommodation level at given fixation distance. The level of convergence needed to perform the procedure would not be changed, thus accommodation/vergence relationship allowing clear and single vision would be altered. Also, the card allows introducing BI or BO prisms in order to change required vergence levels, thus making the exercise more or less challenging. In such a case accommodative demand does not change, therefore the relationship between accommodation and vergence is altered again. In addition, in later stages of training, a combination of prisms and lenses (BIM, BOP) can be introduced to elevate difficulty of the task, and therefore, the possible benefits from training.

### EYE HAND COORDINATION

The patient can be asked to touch the currently fixated arrow heads. This will assure precise using of motor response (hand movement) with desire fixation at a given distance.

A pen or a finger can also be used while smooth vergence movement is elicited. In addition to enhancing eye hand coordination, an object placed at and moved with the fixation point provides supplement information for vergence system. It might be easier for a patient to observe a single tip of the object at the crossing of the edge.

### USE OF RHYTHM AND/OR AUDIAL CUES

A metronome or music with a beat can provide patient with rhythmic cues to change vergence while eliciting jump vergence movement between arrow pairs. The rhythm rate used however should allow for stopping at each pair to assure correct image of the observed arrows tips (see above). Therefore, if music is used the change should not be every measure. Voice comments using colors of the arrows can be used to provide jump vergence changes with random demand of change in convergence (not in order jumps).