Effect of Optometric Visual Therapy on a Cohort of mTBI patients with Oculomotor (OM) and Visual Information Processing (VIP) deficits

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COVD 2021

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Introduction

- Approximately 40% of the primate brain is primarily visual machinery[1].
- Patients with oculomotor deficits have been found to have a 10.72x higher risk of being from a PCS (post concussion syndrome) group as opposed a control group)[2].
- Baseline testing of varsity athletes who have had concussions reveals that despite being cleared to play, that 16-18% have significant functional visual deficits[3].
- Former athletes who have suffered multiple concussions have a 5-fold higher prevalence of mild cognitive impairment (MCI, a condition that converts at a rate of 10-20% annually into dementia) compared to retired athletes without a history of concussion[4].
- High frequency of of civilian and military mTBI cases manifest oculomotor problems (50-90%), with the most common symptoms being related to reading speed and comprehension[5] with a 3x higher incidence of suicide in the mTBI population overall[6].
- Previous research has shown that poor reading skills are associated with poor oculomotor skills in a large cohort of paediatric cases without concussion[7].
- Research to date suggests that oculomotor deficits and visual processing deficits as a result of mTBI can be effectively treated with an appropriately structured optometric vision therapy program[8,9], but more data is needed.
- mTBI consensus guidelines published in Canada (McMaster Medical School) in 2015 specifically recommends "referral to a qualified optometrist specializing in neuro-optometric rehabilitation for vision therapy"[10].
- The FCOVD process provides a reasonable framework for ensuring that any optometrist involved in the rehabilitation of mTBI cases and / or vision related learning difficulty cases sufficient expertise to treat said cases. In addition, COVD has had an external review of the Fellowship process done to enable "Board Certification designation.
- This research was done using data from a clinic run by two FCOVD Optometrists on a population of mTBI cases in a clinical facility dedicated solely to VT.

Purpose

The main aim of this research was to establish the effect of rehabilitative vision therapy on the oculomotor, visual processing Quality of Life metrics of patients with mTBI based injuries (all designated PCS, all >12 months post-injury) who completed the VT program.

Methods

- **Subjects**:
  - 110 cases (18-68 years old, 78% female) who completed our in-office VT program.
  - Retrospective chart review as all oculomotor data (OM) and visual information processing (VIP) data collected as part of clinic protocol every 10 sessions.
  - Data collected from two main FCOVD doctor records and standardized visual processing battery done by VT team (i.e. COVTs).
- **Protocol:**
  - Data collected (PQ and DC) from all clinic files.
  - Several OM and VIP metrics tracked (including visual memory).
  - TOSWRF-2 reading efficiency test used for measure of reading efficiency.
  - Retrospective cross-sectional file review approach.
- **Points of note**:
  - Average number of VT sessions (rounded) to graduation: 30 (1 SD: +/-5 sessions).
  - VIP tests included in analysis: TVPS (3rd Edition), DTVP-A, DEM, TOSWRF-2.
  - OM tests included in analysis: MAF (+/-2DS), BAF (+/-2DS), 12BO/3BI (near), stereopsis (randot), NPC testing.
  - Questionnaires included in analysis: CISS Questionnaire, COVD QoL Questionnaire.
  - Other interventions may have been on-going at the time also as is common in mTBI cases (i.e. PT, OT, DC etc.).
  - Cases with positive MRI findings (i.e. lesions) or diagnosed migraine were excluded.

Results

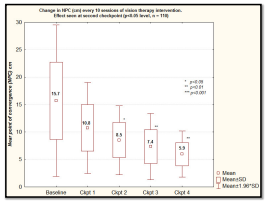

Figure 1: Change in near point of convergence (NPC, cm) at baseline and at every 10 session VT checkpoint. Significant improvement is noted by 20 sessions (p<0.01 level) and by 30 sessions p<0.01 level).

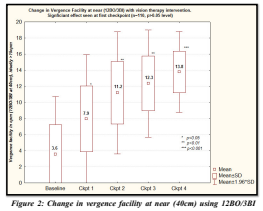

Figure 2: Change in vergence facility at near (40cm) using 12BO/3BI testing at baseline and at every 10 session VT checkpoint. Significant improvement is noted at 10 sessions (p<0.01 level) and at 20 sessions (p<0.01) and also at 40 sessions (p<0.001).

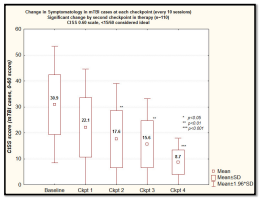

Figure 3: Change in CISS symptom score from baseline to completion of in-office VT program (i.e. graduation). Significant improvement noted by 20 sessions (p<0.01 level).

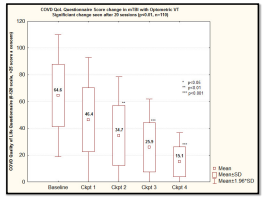

Figure 4: Change in COVD QoL symptom score from baseline to completion of in-office VT program (i.e. graduation). Significant improvement noted by 20 sessions (p<0.01 level).

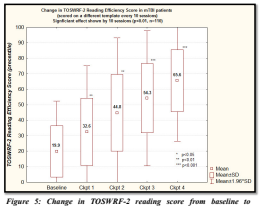

Figure 5: Change in TOSWRF-2 reading score from baseline to completion of in-office VT program (i.e. graduation). Significant improvement noted by 10 sessions (p<0.01 level).

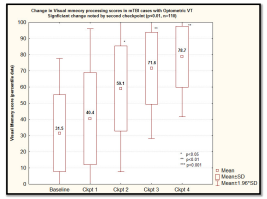

Figure 6: Change in Visual Memory scores from baseline to completion of in-office VT program (i.e. graduation). Significant improvement noted as early as 20 sessions (p<0.05 level).

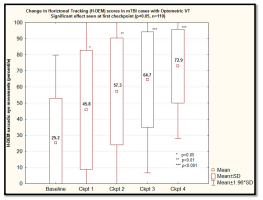

Figure 6: Change in TOSWRF-2 reading score from baseline to completion of in-office VT program (i.e. graduation). Significant improvement noted by 10 sessions (p<0.01 level).

Results of note:

- NPC: 15.7cm start of VT to 5.9cm on graduation.
- COVD QoL symptom score improved from 65 at baseline to 15 on completion VT program.
- TOSWRF-2 reading score: Average 20th percentile baseline to 66th percentile on graduation.
- Almost all VIP and OM metrics start to show significant changes by 10 sessions.
- Symptom scores did not appear to start to significantly improve until after 20 sessions, which is important to note in the initial counseling of patients in terms of expectations.
- Vergence facility at near improved from 4cpm to 14cpm on average for those completing VT.

Discussion

- In prior research[7] in Learning Difficulty (LD) paediatric cases in non-mTBIs, a combination of vergence facility and symptom scores was found to be highly predictive of reading using an infra-red tracking system.
- Vergence facility, among several other OM metrics including saccadic eye movements, was found to be improved with in-office optometric vision therapy with a concurrent improvement in TOSWRF-2 reading scores.
- Reading scores appear to rise on the TOWSRF-2 in line with vergence facility and saccadic tracking improvements with the gains appearing faster than in non-mTBI cases. This is presumably as the "reading machinery" was present prior to the mTBI in most cases, which may not be the case in the LD cases.
- Similar gains in reading in LD cases took twice as long as the mTBIs in this study (see 2019 COVD poster on LD cases).
- There is a beneficial effect of in-office Optometric Vision Therapy in mTBI cases as measured by COVD QoL scores.
- Although OM metrics and some VIP metrics show significant change even by the first checkpoint (10 sessions in this study), COVD QoL and CISS symptom scores did not ***start*** to improve until the second checkpoint (i.e. 20 session mark).
- It appears that mTBI related OM and VIP scores be remediated, but that the time to symptom improvement does not follow in direct time correlation to the time course for OM and VIP metrics improvement.
- It is important when counselling mTBI cases on VT intervention that symptom changes may not be apparent until the second checkpoint (i.e. 20 session mark) but that usually OM and VIP changes are often present as early as the first checkpoint. Not understanding this at the start of VT may result in early drop out of VT from the patient's perspective.

Conclusions

- Similar to LD cases[7], routine eye examinations simply determining ophthalmic Rx and normal retinal health to be insufficient in detecting OM and VIP visual issues linked to mTBI as shown in the OM and VIP baseline data presented.
- In-office vision rehabilitation is significantly effective in improving OM and VIP metrics in mTBI, which appear to have a beneficial effect on TOSWRF-2 reading efficiency scores.
- Although significant improvement is seen at 10 weeks (i.e. first checkpoint) in almost all OM data, statistically significant changes were not apparent in symptom scores until the 20-session checkpoint (i.e. second checkpoint) as measured on CISS and COVD QoL Questionnaire.
- Counseling on the fact that symptom change will start to occur around 20 sessions despite OM and VIP metrics changing as early as 10 sessions is important to emphasize in an in-office Optometric Vision Therapy program geared towards mTBI cases.
- Optometric Vision Therapy appears to be highly effective in cases that complete the program.
- These findings are in line with specific visual dysfunction management recommendations in Canada[10] from both Medicine and Psychiatry in their Clinical Practice Guidelines for mTBI cases with persistent symptomatology.

References & Acknowledgements

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Acknowledgements: We would like to thank the Government of Canada for funding (Scientific Research & Experimental Development grant , SR&ED)