

Journal of Pediatric Ophthalmology & Strabismus

Acute Acquired Concomitant Esotropia from Excessive Application of Near Vision during COVID-19 Lockdown --Manuscript Draft--

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Full Title:	Acute Acquired Concomitant Esotropia from Excessive Application of Near Vision during COVID-19 Lockdown
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Abstract:	The public health measures imposed in many countries to slow the spread of the COVID-19 outbreak could have negative effects on children's physical and mental health. This case series reported 4 cases of acquired concomitant acute esotropia likely caused from excessive application of near vision during the COVID-19 lockdown.
Author Comments:	
Response to Reviewers:	<p>We appreciate the Editor and the Reviewer for the opportunity to revise our work for consideration for publication on Journal of Pediatric Ophthalmology and Strabismus. We hope that the helpful comments of the reviewer really contributed to make our paper stronger. Reviewer' comments are shown in bold, Authors' reply in normal text.</p> <p>Reviewer #1: The authors have submitted 4 case reports of acute onset esotropia which occurred to 4 children in Italy, while under quarantine for COVID-19. Nothing could be more timely, and the cases are interesting. However, the manner in which they are reported needs to be revised before this paper can be published. The paper starts by reviewing the European categories of acute esotropia - Swan, Franceschetti, and Bielschowsky types, and then while presenting the the 4 cases, tries to assign the cases to the types they list in the introduction. The authors would be better served by simply presenting the cases without assignment to type, - just the facts of the cases without editorialization. In the first case, they assign the child to the Franceschetti type which they have stated usually has physical or psychological stress. Then they say this case had no physical or psychological stress. The Bielschowsky types they present here had some myopia, but as the authors point out, no uncorrected myopia which Bielschowsky postulated. So these cases don't really fit the categories.</p> <p>There is no reason to try to fit the cases into categories in the case descriptions. It does not add anything at that point. The analysis of the cases, including assignment into types belongs in the discussion section. There, the authors a free to interpret the data so it makes a more understandable. I do not think these types add anything to the understanding of the acute onset esotropias presented here. This is a novel presentation in a Novel coronavirus time. It is more related to the recent reports of esotropias in increased near viewing behavior, reported in the references that the authors appropriately cite. This is an interesting and important topic. Unfortunately, in the rush to get this timely report to publication, the presentation is not organized in clear and well thought out manner. Present the cases without assignment to categories, then make a clear argument in the discussion, and resubmit. These cases</p>

deserve to be seen.

Thanks for the positive comments. We believe that these cases can raise awareness among clinicians about this emerging clinical condition closely linked to the measures adopted worldwide to manage the ongoing health crisis.

In the period in which the article was under review, we observed a new case of acute acquired concomitant esotropia that seems to be linked to excessive application of near vision. Being that the maximum word count has almost been reached, we cannot report this case in the article. However, we would like to share it with the editors and the reviewer:

A 13-year-old male presented to the Ophthalmology Department of the Policlinico Mater Domini (Catanzaro, Italy), with acute onset of large angle esotropia and horizontal diplopia 20 days before. His ocular history was not significant for refractive error, strabismus, trauma, or recent illness, but the patient's parents reported the use of smartphone and tablet for at least 8 hours a day in the past 3 months, since the introduction of homeschooling. On examination, his visual acuity was 20/20 in both eyes and cycloplegic refraction demonstrated 1 diopters of hyperopia bilaterally. Alternate prism cover testing demonstrated a comitant esotropia of 45 prism diopter at far and near distances; ductions and versions were full, without signs of incomitance, confirmed by the Hess chart. Sensorimotor examination, including Bagolini striated glass test and TNO stereo test, demonstrated normal binocular function with prismatic correction. Magnetic resonance imaging of the brain and orbits was normal. The patient had already been evaluated by a neurologist with normal results and, for empirical treatment, was prescribed oral corticosteroids, which he stopped due to lack of improvement.

We are aware of how difficult and sometimes impossible it is to classify a clinical event within a rigid categorization. We agree with the reviewer that some of the cases presented did not fit perfectly the classification criteria and, above all, that this is not the main focus of our communication. We modified the text in accordance with the reviewer's suggestions and we removed the assignment to the categories.

We modified Introduction section as follows:

"Acute acquired concomitant esotropia (AACE) is a relatively rare form of strabismus characterized by a sudden onset of concomitant esotropia with diplopia. The cause of AACE seems to be related with an inability to maintain balance between the converging and diverging forces of the eye, particularly in patients with uncorrected myopia or after physical or psychological stress"

As suggested by the reviewer, we briefly discussed the classification of AACE in the Discussion section:

"AACE is reported to occur typically in patients with unilateral vision loss (Swan-type), mildly hyperopia, in association with physical or psychological stress (Franceschetti-type) or uncorrected myopia (Bielschowsky-type). However, in our series, the traditional classification of AACE shows some limitations. In fact, both myopic patients (#2 and #3) wore glasses, and no one were reluctant to wear them, and the other two patients (#1 and #4), presented mild hyperopia but no history of physical or psychological stress."

Finally, we discussed more in detail the possible mechanism underlying the onset of

"The authors speculated that excessive smartphone use could lead to accommodation and vergence abnormalities, resulting in dynamic preponderance of the medial rectus muscles, thus in the development of manifest esotropia."

Additionally, the authors state that they deferred neuroimaging for at least one of the patients, then, in the discussion state that neuroimaging was normal in all four patients.

Thanks for this comment that allows us to correct an imprecision. Actually, neuroimaging was deferred only in patient of case #1. In any case, as stated in the text, the patient of case 1 had undergone neurological examination that was unremarkable. In addition, while the article was under review, the patient performed a

MRI scan that showed no alterations. We added this finding in the description of case 1 and we clarified the description of cases 2 and 3:

“Case 1. [...] Neurologic evaluation and brain magnetic resonance imaging (MRI) under sedation were unremarkable and a diagnosis of AACE was reached. [...]”

“Case 2. [...] Neurologic evaluation and MRI, carried out in the emergency room, were normal. [...]”

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Acute Acquired Concomitant Esotropia from Excessive Application of Near Vision during COVID-19 Lockdown

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1 **Acute Acquired Concomitant Esotropia from Excessive Application of Near Vision during**
2 **COVID-19 Lockdown**

3 *Journal of Pediatric Ophthalmology and Strabismus – Short Subject*

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27 **Abstract**

28 The public health measures imposed in many countries to slow the spread of the COVID-19 outbreak
29 could have negative effects on children's physical and mental health. This case series reported 4 cases
30 of acquired concomitant acute esotropia likely caused from excessive application of near vision
31 during the COVID-19 lockdown.

32

33 **Introduction**

34 While COVID-19 continues to spread across the globe, many countries have instituted a range of
35 public health measures to slow transmission and ease the burden on health systems. Among these,
36 school closures are affecting almost 70% of the world's student population.¹ Although these measures
37 are necessary to deal with the outbreak, there are concerns that they might have negative effects on
38 children health, including weight gain, sleep disruption and psychosocial stress.² Moreover,
39 insufficient time spent outdoors and excessive near work might be associated with an increased risk
40 of myopia.^{3,4}

41 **Acute acquired concomitant esotropia (AACE) is a relatively rare form of strabismus characterized**
42 **by a sudden onset of concomitant esotropia with diplopia. The cause of AACE seems to be related**
43 **with an inability to maintain balance between the converging and diverging forces of the eye,**
44 **particularly in patients with uncorrected myopia or after physical or psychological stress.⁵ Recently,**
45 **AACE has been associated with excessive application of near vision due to the widespread adoption**
46 **of computers, tablets and smartphones.^{6,7}**

47 We report the cases of 4 young patients who developed AACE associated with excessive near work
48 during the COVID-19 lockdown.

49

50 **Case Reports**

51 *Case #1*

52 A 4-year-old female presented with acute onset of diplopia to the Eye Clinic of the Policlinico San
53 Martino (Genoa, Italy). Two days before presentation, the parents noted crossed eyes when she woke
54 up. She had no history of recent infections, physical or psychological stress. In the last 2 months the
55 child spent approximately 8 hours a day using tablet. Best-corrected visual acuity (BCVA) was 20/25
56 in both eyes. Stereopsis was not detectable by Lang. Manifest esotropia was 35Δ at both far and near
57 distances in all positions of gaze. The cycloplegic refraction was +2.00 sphere in both eyes. Ductions
58 and versions were full, with no apparent inferior oblique overreaction or alphabet pattern. **Neurologic**
59 **evaluation and brain magnetic resonance imaging (MRI) under sedation were unremarkable and a**
60 **diagnosis of AACE was reached.** A +1.50 glasses full time was prescribed although other treatment
61 options such as prisms, strabismus surgery or botulin toxin injection were discussed.

62

63 *Case #2*

64 A 16-year-old male presented with acute onset of diplopia to the Eye Clinic of the Policlinico San
65 Martino (Genoa, Italy). He had no history of recent infections, physical or psychological stress. The
66 patient reported an intense use of computer for more than 8 hours a day. He has wearing glasses for
67 myopia since he was a child. Best-corrected visual acuity (BCVA) was 20/20 in both eyes. Stereopsis
68 was normal at Lang test. In alternate cover test, the manifest esotropia was 30Δ at both far and near
69 distances in all positions of gaze (Figure 1). Ductions and versions were full, with no pattern
70 strabismus. Bagolini striated glasses excluded presence of monofixation syndrome. The cycloplegic
71 refraction was -2.50 sphere in the right eye and -2.25 sphere in the left eye. Neurologic evaluation
72 **and MRI**, carried out in the emergency room, **were** normal. A diagnosis of AACE was made, Fresnel
73 prism prescription as a temporizing measure was advised and the possibility of symmetrical medial
74 recti recession or botulinum toxin were discussed.

75 *Case #3*

76 A 16-year-old male presented to the IRCCS Fondazione Bietti (Rome, Italy) reporting acute diplopia
77 in the last 2 days. His current prescription was -0.50 sphere in both eyes. The patient reported an
78 intense use of computer for more than 10 hours a day. Upon examination, he had 20/20 BCVA in
79 both eyes. Stereopsis was normal at TNO test. The deviation angle of esotropia was 20Δ at both far
80 and near distances. Ductions and versions were full with no pattern strabismus. Bagolini striated
81 glasses evaluation was normal. The cycloplegic refraction was -0.50 sphere in both eyes. **Neurologic
82 examination and neuroimaging showed no alterations.** A diagnosis of AACE was made and Fresnel
83 prism was prescribed as a temporizing measure.

84

85 *Case #4*

86 An 8-year-old female presented to the Ophthalmology Department of the Policlinico Mater Domini
87 (Catanzaro, Italy), reporting the acute onset of diplopia 10 days before. The patient's parents reported
88 the use of tablet for a minimum of 8 hours a day since the introduction of homeschooling. After the
89 onset of diplopia, the patient discontinued the use of devices and experienced an improvement in
90 symptoms during the next days. The examination of a photo took at the onset of diplopia revealed a
91 deviation of at least 40Δ . Upon examination, she had 20/20 BCVA in both eyes. Stereopsis was
92 normal at TNO test. Ductions and versions were full with no signs of incomitance. Manifest esotropia
93 was 25Δ at both far and near distances. The cycloplegic refraction was +1.00 sphere bilaterally.
94 Neurologic evaluation was unremarkable and brainstem MRI yielded negative response. A diagnosis
95 of AACE was made and the patient was recommended to severely limit the use of computer and
96 tablet.

97

98

99 **Discussion**

100 We described 4 cases of AACE occurred during the COVID-19 national lockdown in Italy. AACE is
101 reported to occur typically in patients with unilateral vision loss (Swan-type), mildly hyperopia, in
102 association with physical or psychological stress (Franceschetti-type) or uncorrected myopia
103 (Bielschowsky-type). However, in our series, the traditional classification of AACE shows some
104 limitations. In fact, both myopic patients (#2 and #3) wore glasses, and no one were reluctant to wear
105 them, and the other two patients (#1 and #4), presented mild hyperopia but no history of physical or
106 psychological stress. Interestingly, all patients spent 8 to 10 hours a day using computers, tablets and
107 smartphones to play, access school lessons and navigate social networks.

108 Some authors have emphasized that AACE can be associated with intracranial disease.⁸ Nevertheless,
109 in all cases herein presented, neurologic examination and neuroimaging were unremarkable, and no
110 ophthalmological signs related with neurologic involvement were observed.⁹

111 Although the etiology of AACE is still debated, it has been associated with sustained nearpoint
112 demands due to the excessive use of computers, tablets and smartphones.⁷ In particular, Lee and
113 colleagues documented a series of 12 teenagers with AACE who used smartphones for more than 4
114 hours a day. The authors speculated that excessive smartphone use could lead to accommodation and
115 vergence abnormalities, resulting in dynamic preponderance of the medial rectus muscles, thus in the
116 development of manifest esotropia. Interestingly, the esodeviation improved in all patients after
117 refraining from smartphone use for 1 month. Nevertheless, strabismus surgery was required in 5
118 patients with good postoperative outcomes in terms of ocular alignment and stereoacuity.⁷

119 Since our cases are recent, no follow-up visits able to assess the course of ocular deviation over time
120 are yet available. This issue represents the main limitation of the present case series.

121 In conclusion, prolonged school closure and home confinement during the current COVID-19
122 lockdown are associated with important lifestyle behaviors changes, including a significant increase

123 in screen time.¹⁰ Recent reports highlighted the risk for an increase of myopia burden owing to these
124 new habits.^{3,4} However, the excessive application of near vision might have other detrimental
125 consequences, including the development of AACE. Reducing the number of total hours of screen
126 time as well as the number of consecutive minutes/hours without visual breaks, should be
127 recommended to prevent AACE. Furthermore, in the lockdown era the use of widescreen images
128 displayed within high definition television might extend the distance of vision and prevent the onset
129 of AACE.

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131 **Conflict of Interest:** No conflicting relationship exists for any authors

132 **Financial support:** None

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188 **Figure Legend**

189 **Figure 1:** Composite 9-gaze photograph of type 2 acute acquired concomitant esotropia in a 16-
190 year-old male (case #2). Patient showed manifest esotropia of 30Δ in all positions of gaze and
191 normal ocular version and duction. Written permission was obtained for the publication of the
192 photographs.

Figure 1

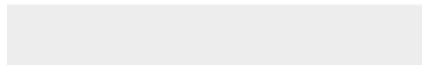
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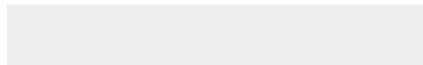
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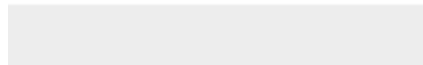
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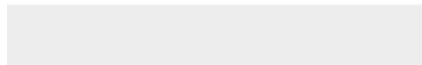
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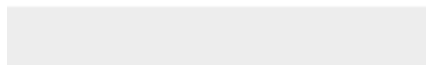
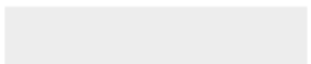
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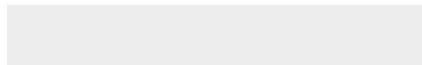
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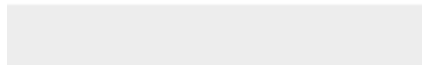
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