



# **+1 TEST AND BINOCULAR BALANCE**

## **THINK**

You have examined a young man, but you are concerned that he may have been accommodating during your refraction examination. If he was accommodating, the results of your refraction will be incorrect. You must check to make sure that his accommodation was relaxed during the refraction examination.

## **AIM**

This unit shows you how to do a +1 test and a binocular balance, and explains why these tests are important.

## **LEARNING OUTCOMES**

When you have worked through this unit you should be able to:

- control accommodation during your refraction
- adjust the refraction if the accommodation of one or both eyes is not relaxed
- make sure that both eyes have equally relaxed accommodation.

## REVIEW: +1 TEST AND BINOCULAR BALANCE

<b>GOALS OF REFRACTION</b>	<ul style="list-style-type: none"> <li>• A refraction must find: <ul style="list-style-type: none"> <li>– the lens that gives the person the clearest vision, and</li> <li>– the lens that gives the person the most comfortable vision.</li> </ul> </li> <li>• The clearest and most comfortable lens is always the lens that has the least amount of minus power (or most amount of plus power) but still gives the best visual acuity (VA).</li> <li>• Young people often see the VA chart clearly with more than one lens – the most comfortable of these lenses is the least minus (or most plus) lens.</li> <li>• You must find the balance between the clearest lens and the most comfortable lens.</li> </ul>
<b>CONTROLLING ACCOMMODATION</b>	<ul style="list-style-type: none"> <li>• The most common mistake that examiners make when they do a refraction is giving the person more minus than they need (or not enough plus).</li> <li>• The person might tell you that their vision looks the same (or even better) if too much minus is added but their VA will not get better (as measured on the VA chart).</li> <li>• If too much minus (or not enough plus) is prescribed as spectacles the person will need to accommodate to see clearly. This can cause asthenopia (eye strain and headaches).</li> <li>• People do not usually know that they are accommodating. They will only tell you that their eyes feel sore or tired.</li> <li>• Over-minused = too much minus in the person's spectacles Under-plussed = not enough plus in the person's spectacles.</li> </ul>
<b>HOW TO AVOID OVER-MINUSING</b>	<ul style="list-style-type: none"> <li>• When you are doing a refraction you must: <ul style="list-style-type: none"> <li>– control the person's accommodation</li> <li>– check to make sure that the person has not been given too much minus.</li> </ul> </li> </ul>
<b>HOW TO CONTROL ACCOMMODATION</b>	<ul style="list-style-type: none"> <li>• Always show the person a plus lens before a minus lens.</li> <li>• When refracting hyperopic eyes → put the second plus trial lens in the trial frame before removing the first plus trial lens.</li> <li>• When refracting myopic eyes → put the second minus trial lens in the trial frame before removing the first minus trial lens.</li> <li>• Check the VA before adding minus lenses (or removing plus lenses) → if the VA does not improve, do not add the minus lens (or remove the plus lens).</li> <li>• Check to see that the person is really seeing better <ul style="list-style-type: none"> <li>- When you hold a minus lens in front of a person's eye ask: "Does this lens let you see more letters or does it just make it look smaller and blacker?" → "smaller and blacker" means that the person is probably accommodating and you are adding too much minus.</li> </ul> </li> <li>• If you think the person is accommodating, add more plus and decrease the plus power slowly → encourage the person to try hard or "guess" the next VA line even if they are not sure.</li> </ul>
<b>CHECK THAT YOU HAVE NOT GIVEN TOO MUCH MINUS</b>	<ul style="list-style-type: none"> <li>• Pay attention to what is happening and what the person is telling you → does it make sense?</li> <li>• Think about the person's symptoms → what sort of refractive error do you expect?</li> <li>• Look at the person's unaided VA → how much refractive error do you expect?</li> <li>• Watch the person's changing VA → you should expect one line of improvement for every 0.25 D change in lens power → is the VA changing unexpectedly?</li> <li>• Look at the person's pinhole VA → the final aided VA should be at least as good as the pinhole VA.</li> <li>• The +1 test → does an extra +1.00 D make the person's VA at least two lines worse?</li> </ul>

## AFTER THE BEST VISION SPHERE (AND SPHERO-CYL) REFRACTION

### OVER-MINUSING AND THE +1 TEST

Even experienced examiners over-minus (or under-plus) by accident sometimes when they do a best vision sphere (BVS) refraction.

This is because it can be difficult to control a person's accommodation.

Over-minusing (or under-plussing) can give a person asthenopia and headaches – but their vision might still be clear. Sometimes the symptoms of asthenopia or headaches will be so bad that the person will not be comfortable wearing their spectacles.

Young people can accommodate a lot, which might make it difficult for you to find their true refractive error. This can happen in both hyperopia and myopia.

- **Myopia**

A myope can be over-minused.

Your refraction can show more minus than is really there.

This can mean that the person will get spectacles that are too strong.

- **Hyperopia**

A hyperope can be under-plussed.

Your refraction can show less plus than is really there.

This can mean that the person will get spectacles that are not strong enough.

The +1 test is a good way to make sure that the person's accommodation was relaxed during the refraction – and that you have not given the person too much minus (or not enough plus).

If you discover that a person has been over-minused you can fix your refraction so that the person will be comfortable wearing their spectacles.

### BALANCING ACCOMMODATION

The two eyes cannot accommodate by different amounts.

If one eye accommodates the other eye must accommodate by the same amount.



**Figure 20.1:** Two bulls that are yoked together must move forwards together by the same amount. If one bull tries to go forward, the other bull must too

You can think of the accommodation of the two eyes as being like two bulls that are yoked together. If one eye uses its ciliary muscle to accommodate, the other eye must do the same.

If one eye needs to accommodate more than the other to see clearly, there will be rivalry between the two eyes – they will fight each other. This can cause asthenopic symptoms and headaches. If both eyes have equally relaxed accommodation the eyes will feel most comfortable.

To relax the same amount of accommodation in both eyes we do a binocular balance.



A binocular balance makes both the need for accommodation and the VA of the two eyes equal.

## AFTER THE BEST VISION SPHERE (AND SPHERO-CYL) REFRACTION (cont.)

### BALANCING ACCOMMODATION (cont.)

You cannot balance the VAs of the two eyes if the best corrected VA of one eye is worse than the other (such as from a cataract). If you try to balance the VA of both eyes you will make the VA in the good eye worse.

If one eye has poor best corrected VA you cannot do a binocular balance. Instead you must be extra careful when you are doing your refraction.






#### NOTE:



Only the spherical lenses of the refraction can be changed during the +1 test and the Binocular Balance. If there are cylindrical lenses in the trial frame, the power and the axis of these lenses will stay the same.

## +1 METHOD



The time to do the +1 test is after you have done your BVS refraction (and sphero-cyl refraction) for both eyes. Make sure that you remember to measure the best corrected VA for the right and left eyes.

<b>STEP 1</b>	Remove the occluder so that both eyes can see the distance VA chart. Leave the BVS or sphero-cylindrical refraction lenses in the trial frame.
<b>STEP 2</b>	Measure distance binocular VA (the person looks at the chart with both eyes open).
<b>STEP 3</b>	Tell the person that you are going to make everything look blurry.
<b>STEP 4</b>	<p>Take two +1.00 D lenses from the trial set and put one in front of each eye (do not remove all the other lenses that are there from your BVS and/or sphero-cyl refraction).</p> <div data-bbox="481 685 598 792" data-label="Image">  </div> <p>When we blur a person's vision by adding plus, we say that we are "fogging" their vision.</p> <p>If we add a fog during a refraction, the accommodation should relax.</p> <div data-bbox="580 853 1398 1249" data-label="Image">  </div> <p><b>Figure 20.2:</b> A real fog (or "mist") is caused by water drops that hang in the air – like a cloud. It is hard to see things when the weather is foggy. It looks a bit like air pollution (or smoke) in cities – sometimes this is called smog.</p>
<b>STEP 5</b>	Measure binocular VA again (with these extra +1.00 D lenses). The VA should be between two and four lines worse.
<b>STEP 6</b>	If the VA is more than two lines worse: go to Step 9. If the VA is the same or only one line worse → go to Step 7.
<b>STEP 7</b>	<p>If the VA is the same or only one line worse → add +0.25 D to both eyes.</p> <div data-bbox="481 1637 598 1744" data-label="Image">  </div> <p>If the VA is the same or only one line worse, you know that you have given the person too much minus (or not enough plus) during your refraction.</p> <p>The person was accommodating during your refraction.</p>

## +1 METHOD (cont.)




<b>STEP 8</b>	<p>Measure the VA again. The VA should be two lines worse.</p> <p>Repeat Steps 6 and 7 until the binocular VA is more than two lines worse (compared with the binocular VA that you measured in Step 2).</p>
<b>STEP 9</b>	<p>Look at the best corrected VA for the right and left eyes (that you measured and wrote down at the end of your BVS and/or sphero-cyl refraction).</p> <p>If the best corrected VA for the right and left eyes are almost the same you now need to do a binocular balance → go to binocular balance method.</p> <p>If the best corrected VA for the right and left eyes are different you cannot do a binocular balance → go to Step 10.</p> <div>  <p>After Step 9 of the +1 test, you need to do a binocular balance – but only if the best corrected VA for the right and left eyes is the same.</p> <p>If the best corrected VA for the right and left eyes is different, you need to continue with Step 10 of the +1 test.</p> </div>
<b>STEP 10</b>	Decrease the power of the lenses in front of both eyes by 0.25 D.
<b>STEP 11</b>	<p>Measure the binocular VA with these lenses.</p> <p>You should expect the VA to improve by approximately one line.</p> <p>Encourage the person to try the line below (you can tell them that they can guess even if they are not sure).</p>
<b>STEP 12</b>	Repeat Steps 10 and 11 until the VA stops getting better.
<b>STEP 13</b>	<p>Measure the VA of the good eye with the trial lenses (occlude the poor eye).</p> <p>The VA should be the same as the best corrected VA you measured for this eye after your BVS or sphero-cyl refraction.</p> <p>If the VA of the good eye is worse than what you found during the refraction, add -0.25 D and measure the VA again.</p> <div>  <p>Make sure that the person's good eye sees as clearly as possible. They will depend on this eye!</p> </div>
<b>STEP 14</b>	<p>Measure the VA of the other eye (occlude the good eye).</p> <p>The VA should be the same as the best corrected VA you measured for this eye after your BVS or sphero-cyl refraction.</p>
<b>STEP 15</b>	<p>Write down the spectacle prescription (the total of all the lenses in the trial frame) for each eye.</p> <p>Write down the aided VA for each eye (it will be different for each eye).</p>

## BINOCULAR BALANCE METHOD

<b>STEP 1</b>	<p>Measure the right eye VA (occlude the left eye).</p> <div data-bbox="472 353 596 465">  </div> <p>Do not put the occluder in the trial frame. Just hold it in front of the eye.</p> <p>The VA of the right eye should be slightly worse than the binocular VA.</p>
<b>STEP 2</b>	<p>Measure the left eye VA (occlude the right eye).</p> <p>If the VA of the left eye is almost the same as the right eye: go to Step 5.</p> <p>If the VA of the right eye and the left eye are not the same: go to Step 3.</p>
<b>STEP 3</b>	<p>Add +0.25 D to the better eye.</p> <p>Measure the VA of this eye.</p>
<b>STEP 4</b>	<p>Repeat step 3 until the VA of both eyes is almost the same.</p>
<b>STEP 5</b>	<p>Ask the person to keep both their eyes open.</p> <p>Ask the person to look at a small letter that they can see.</p>
<b>STEP 6</b>	<p>Quickly occlude first the left eye, then the right eye. (You should move the occluder to the other eye every ½ second.)</p> <p>You can say:</p> <p style="padding-left: 40px;"><i>“Is it easier to see with your right eye... or your left eye...?”</i></p> <p style="padding-left: 40px;"><i>Your right eye... or your left eye...?”</i></p> <p>Or... <i>“Is it easier to see with this first eye... or this second eye...?”</i></p> <p style="padding-left: 40px;"><i>The first eye... or the second eye...?”</i></p> <p>Or... <i>“Is it easier to see with number 1... or number 2...?”</i></p> <p style="padding-left: 40px;"><i>1... or 2...?”</i></p>
<b>STEP 7</b>	<p>If the person tells you that both eyes are equally clear → go to Step 9.</p> <p>If the person tells you that one eye is clearer than the other eye → go to Step 8.</p> <div data-bbox="472 1529 596 1641">  </div> <p>You must be extremely careful when you do binocular balance.</p> <p>It is very easy for the person to get confused:</p> <ul style="list-style-type: none"> <li>• The person might tell you that they prefer their right eye when really they mean their left eye.</li> <li>• The person might always prefer the first eye (or the second eye) because that is what they are expecting.</li> </ul>



## BINOCULAR BALANCE METHOD (cont.)

<b>STEP 8</b>	<p>Add +0.25 D to the eye that sees better.</p> <div data-bbox="470 347 1522 481">  <p>If you add more than +0.25 D to one eye, you should check to make sure that the person is not confused.</p> <p>It would be surprising if you added more than +0.50 D to one eye.</p> </div> <p>Repeat Steps 6, 7 and 8 until:</p> <ul style="list-style-type: none"> <li>the person tells you that both eyes are equally clear, or</li> <li>the person has alternate preferences (prefers one eye, then the other eye... so that you find yourself adding +0.25 D to first one eye then the other eye) → in this case choose the lenses that make the eyes most similar in power.</li> </ul> <div data-bbox="470 739 1522 862">  <p>Steps 6, 7 and 8 are sometimes called the alternating balance test.</p> </div>
<b>STEP 9</b>	Measure the binocular VA.
<b>STEP 10</b>	Change the power of the lenses in front of both eyes by -0.25 D.
<b>STEP 11</b>	<p>Measure the binocular VA with these lenses.</p> <p>You should expect the VA to improve by approximately one line.</p> <p>Encourage the person to try the line below (you can tell them that they can guess even if they are not sure).</p>
<b>STEP 12</b>	<p>Repeat Steps 10 and 11 until the VA stops getting better.</p> <p>This is the person's best corrected binocular VA.</p>
<b>STEP 13</b>	Measure the VA of the right eye (occlude the left eye).
<b>STEP 14</b>	Measure the VA of the left eye (occlude the right eye).
<b>STEP 15</b>	<p>If the VA for the right eye and the left eye is the same as the best corrected VAs that you measured after your BVS or sphero-cyl refraction → go to Step 17.</p> <p>If the VA for the right eye or the left eye is worse than for the best corrected VA → go to Step 16.</p>
<b>STEP 16</b>	<p>Add -0.25 D to <i>both</i> eyes and measure the right and left VA again.</p> <div data-bbox="470 1624 1522 1758">  <p>You can only do this step once.</p> <p>If the VA for one of the eyes is still worse than the best corrected VA, you have made a mistake. You need to recheck your refraction.</p> </div> <p>The VA for the right and left eyes should now be the same.</p> <p>The VA for each eye should be the same as the best corrected VA of the right and left eyes before you started the +1 test.</p>



## SUMMARY: THE +1 TEST AND BINOCULAR BALANCE

### AFTER THE DISTANCE REFRACTION

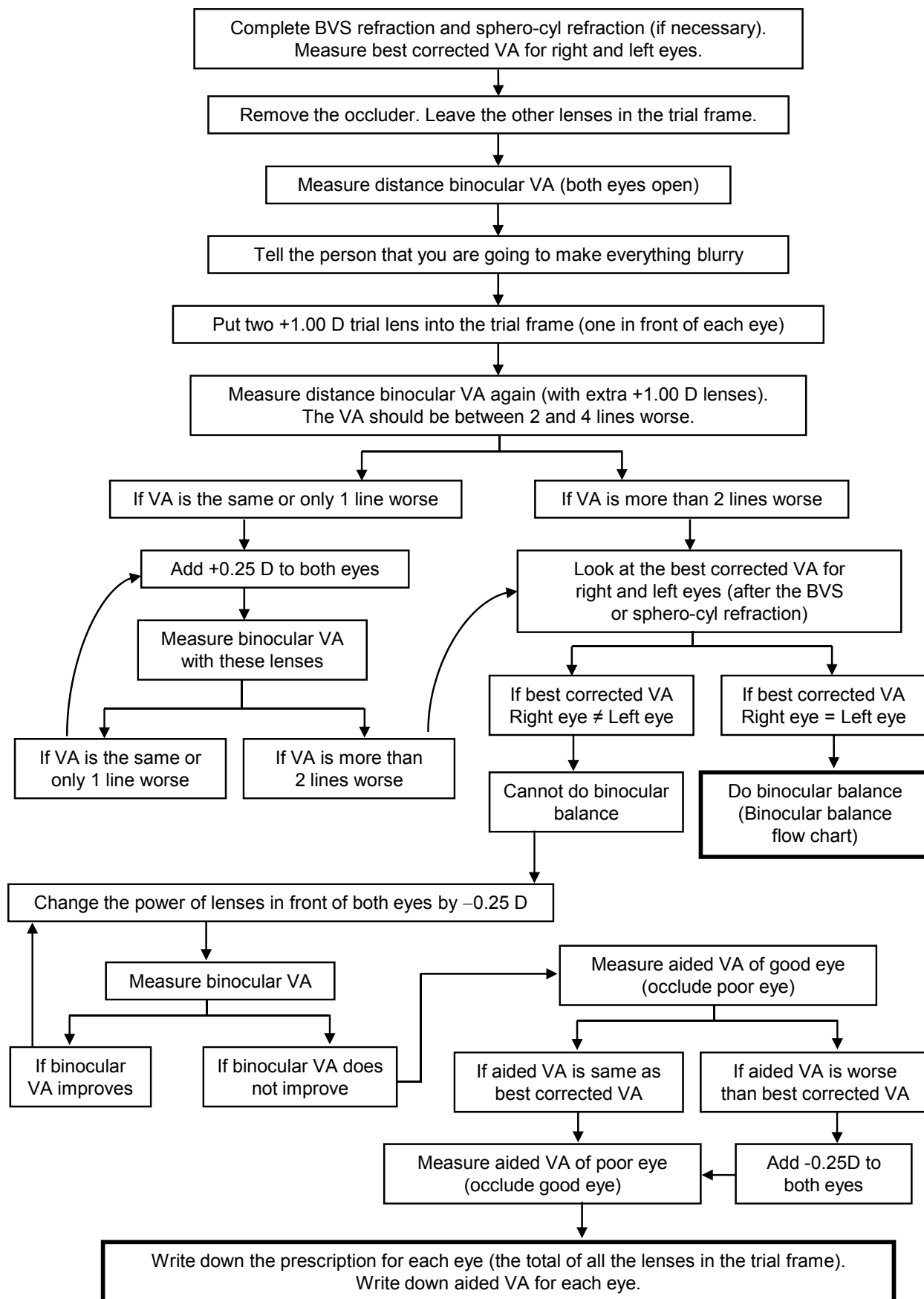
#### Over-minusing / under-plussing and the +1 test:

- It is easy to over-minus (or under-plus) by accident because it can be hard to control a person's accommodation.
- Over-minusing (or under-plussing) can give the person asthenopia and headaches
  - but their vision might still be clear.
- If you over-minus a myope:
  - your refraction shows more minus than is really there
  - the person will get spectacles that are too strong.
- If you under-plus a hyperope:
  - your refraction will show less plus than is really there
  - the person will get spectacles that are not strong enough.
- The +1 test is a good way to make sure that the person's accommodation was relaxed during the refraction
  - and that the person was not over-minused or under-plussed.

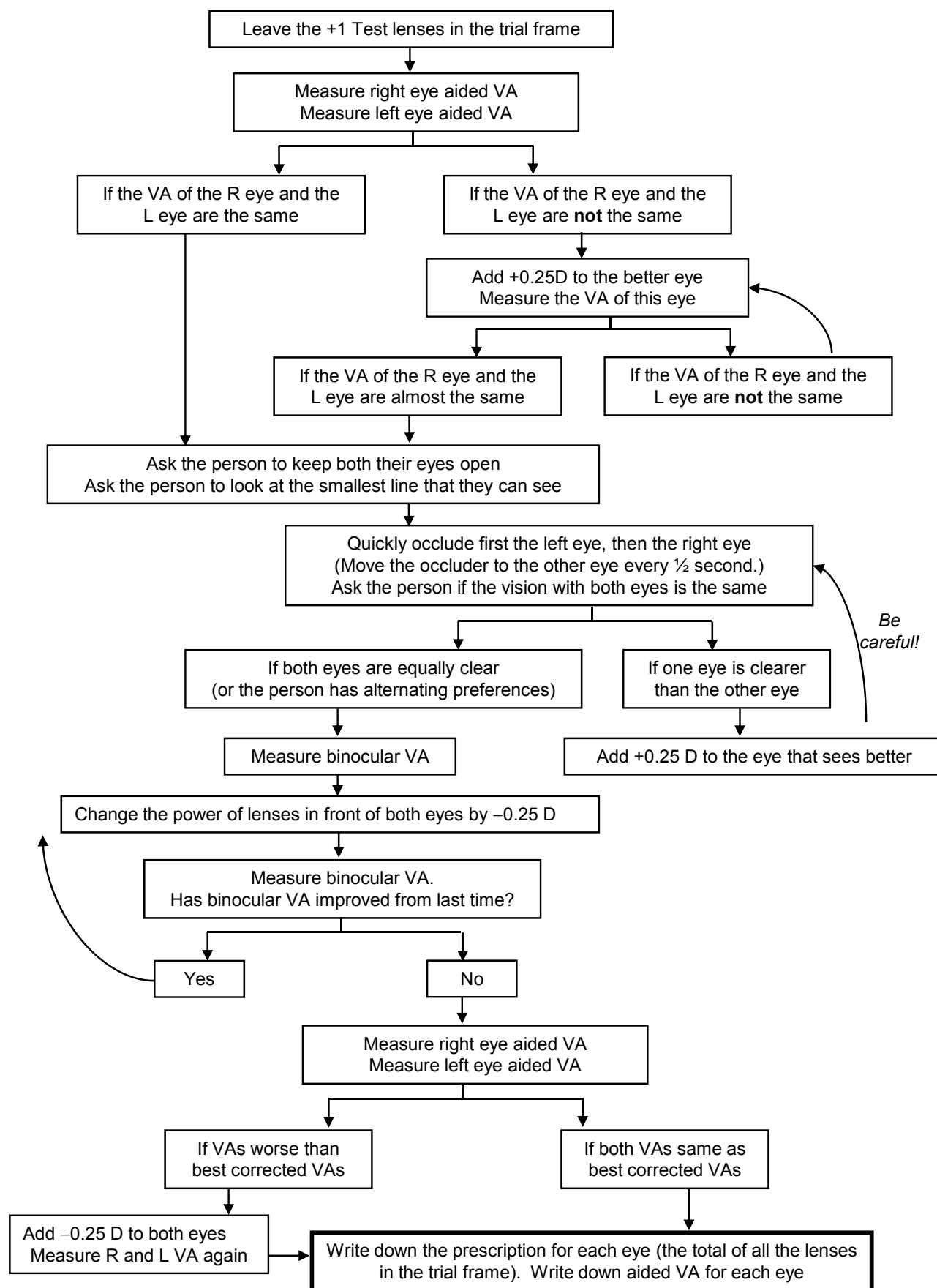
#### Balancing accommodation:

- The two eyes always accommodate by the same amount.
- If one eye needs to accommodate more than the other to get clear vision there will be rivalry (fighting) between the two eyes and vision will be uncomfortable. This is why it is important to make sure that both eyes have equally relaxed accommodation.
- To relax the same amount of accommodation in both eyes we do a binocular balance.
- A binocular balance makes equal
  - the amount of accommodation in the two eyes
  - the visual acuities of the two eyes.
- If one eye has poor best corrected VA you cannot do a binocular balance → instead you must be extra careful when you are doing your refraction

**+1 TEST METHOD**



## BINOCULAR BALANCE METHOD





## TEST YOURSELF QUESTIONS

**1. Why should we do a +1 test?**

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**2. If accommodation was relaxed during the refraction, how much worse should VA be when the +1 test is performed?**

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**3. What are we trying to do when we balance or equalise a refraction?**

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**4. When a refraction is balanced, will both eyes have the same VA?**

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