Trans Tibial Prosthetic Alignment

Chapter 11
P&O UMTY 2018

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What is alignment

- (Bench) alignment means attaching the socket, shank and foot to each other in the proper relationship in the workshop
- Aligning the prosthesis well will save the patient’s energy and makes its use easier.
- He or she will be more comfortable and better able to carry out normal tasks.

Good alignment

- A transtibial amputee who has a well-fitted socket and a well-aligned prosthesis should have a similar gait to a non-amputee.
- Remember that the patient is the most important part of the process.
- Always listen to the patient’s comments and ask his or her opinion.

Definitions

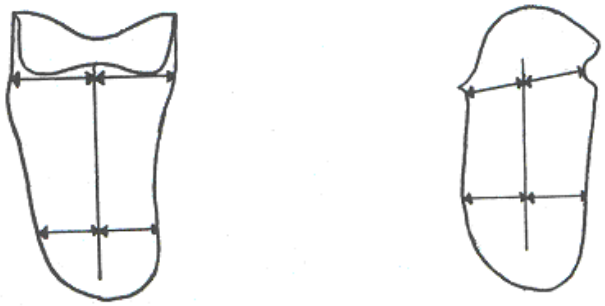
- Gait Deviation
  - The gait that has any differences from what is normal.
- Optimum alignment
  - If any gait deviations are caused by the prosthesis, adjust the prosthesis as needed, and check the patient's walk again.
  - Make sure that the prosthesis is aligned as correctly as possible.

Alignment procedure has 3 steps

- 1 Bench alignment
  - Bench alignment means attaching the socket, shank and foot to each other in the proper relationship in the workshop.
- 2 Static alignment
  - This should be done before the begins to walk on the new prosthesis. Ask patient to stand, and check socket fit, height and stability
- 3 Dynamic alignment
  - When static alignment is correct, it is time for patient to walk and check the gait.

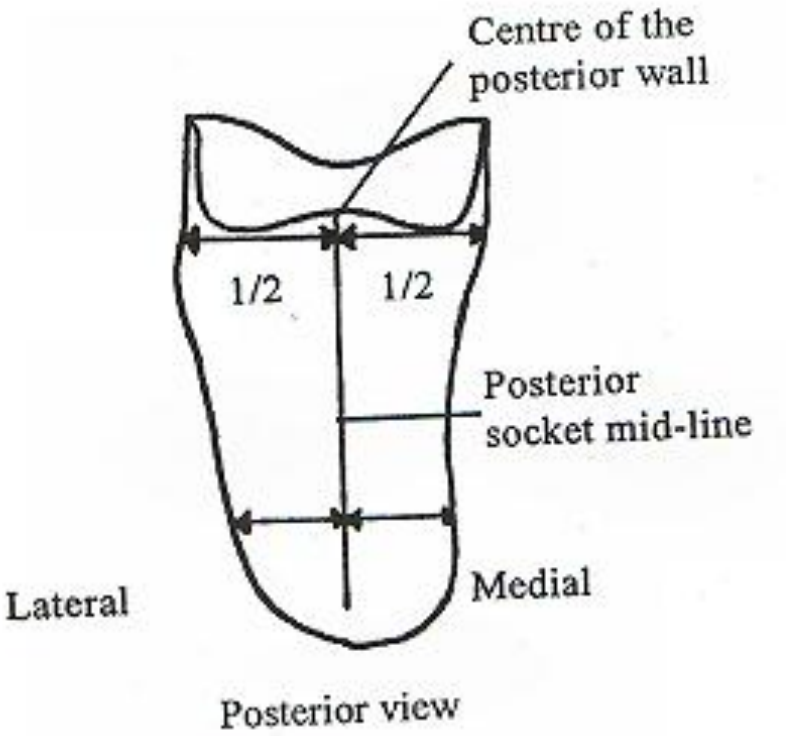
1 BENCH ALIGNMENT

- Before attaching the components to each other, always draw the posterior and lateral reference lines on the socket.

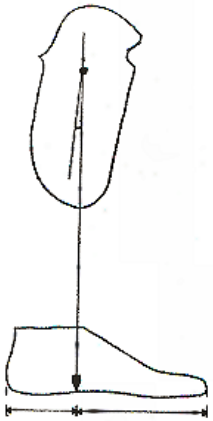


Posterior reference line

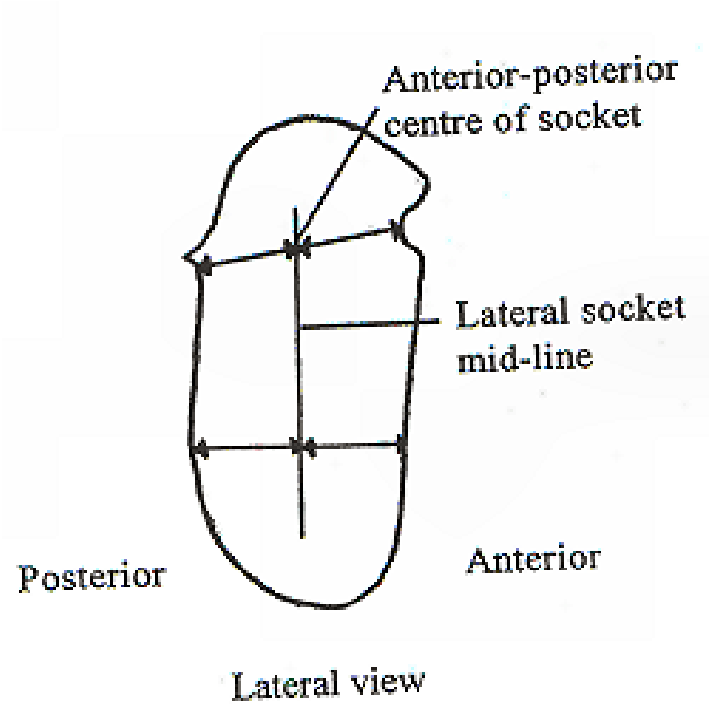
- The posterior socket mid-line connects the center point at the posterior wall with the center point near the distal end. (Fig. 12.1)



Lateral reference line

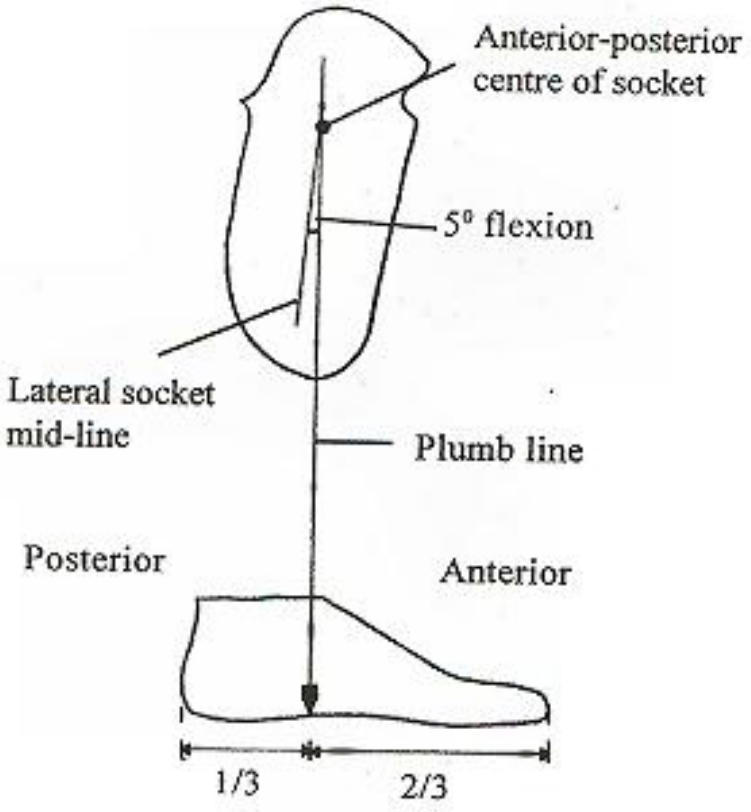


- The lateral socket mid-line connects the mid-point between the patellar tendon and the posterior wall with the center point near the distal end
- (Fig.12.2).



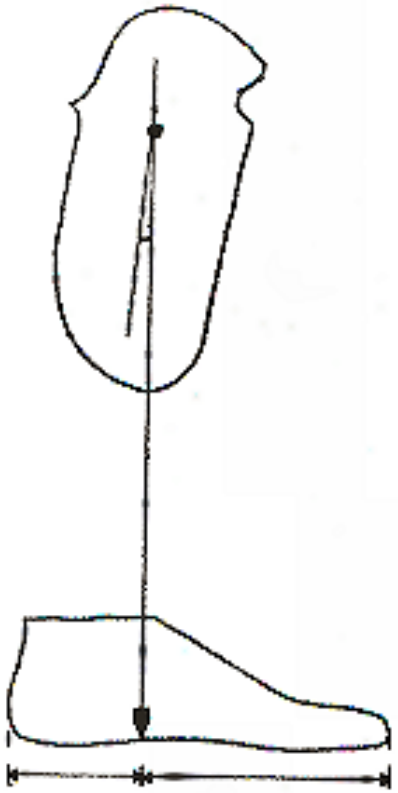
Socket angles

- The socket and foot are usually attached to each other so that the socket is flexed 5°.
- This is so that the front part of the stump will bear more of the weight and more force can be applied to the patella tendon.



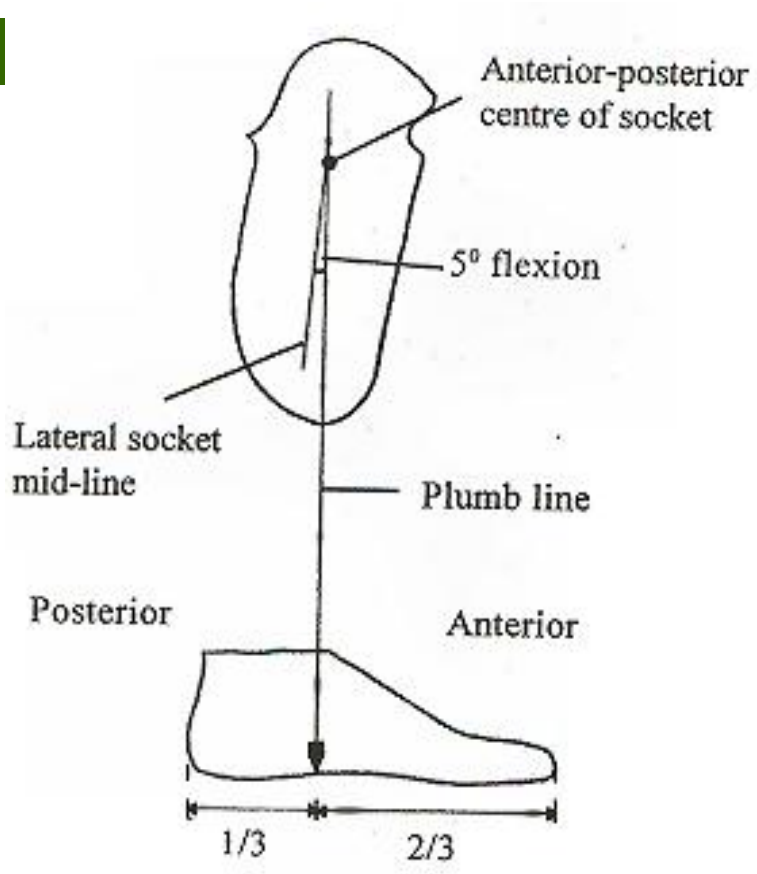
Short stump

- For very short stumps, the flexion should be increased **up to** 15°.

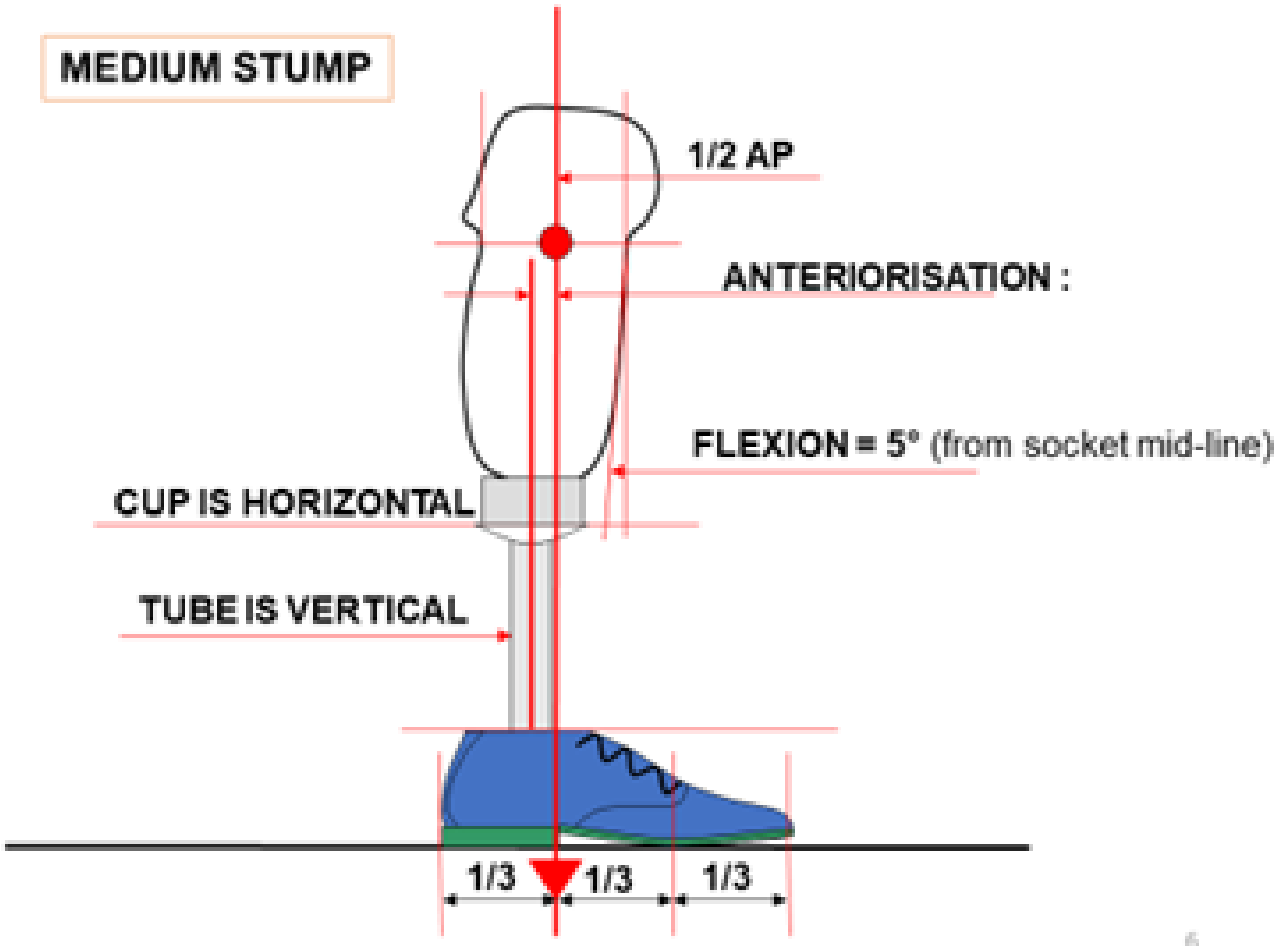


Lateral plumb line

- A plumb line from the antero-posterior center of the socket will fall 1/3 along the foot from the heel, depending on the length of the keel in the foot.

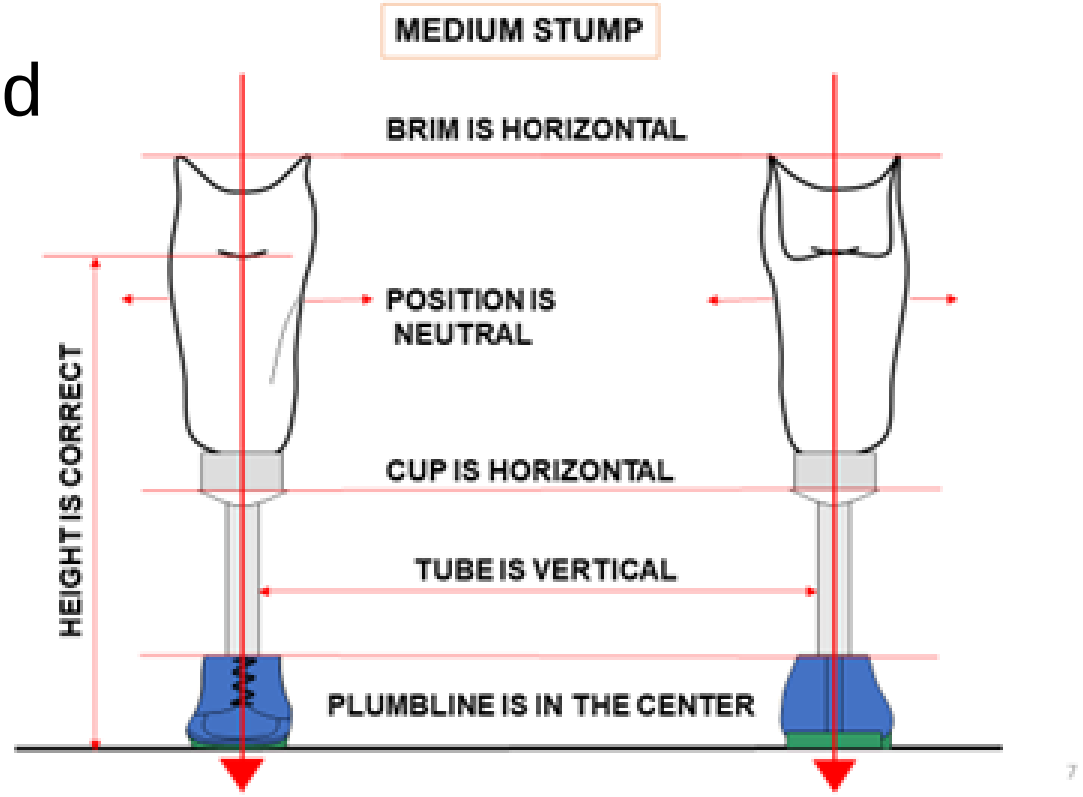


Lateral plumb line



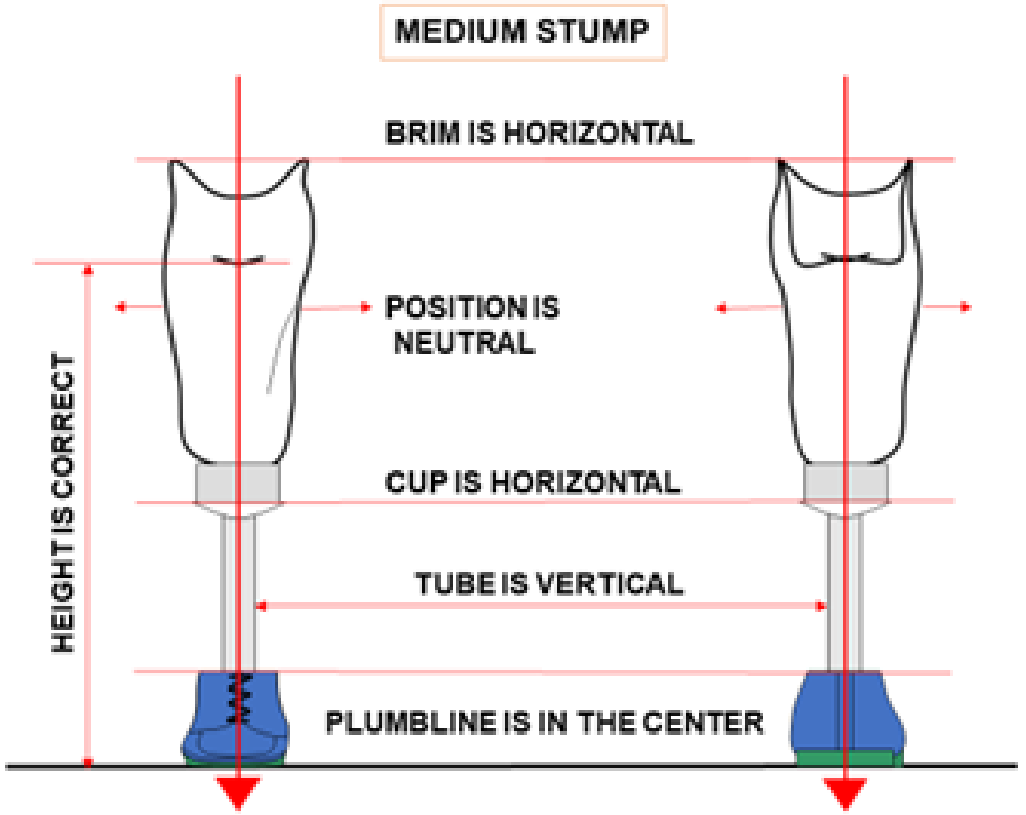
Anterior – posterior view
Socket adduction / abduction

- The socket should be placed in adduction or abduction, to match patient stump as recorded during patient assessment.



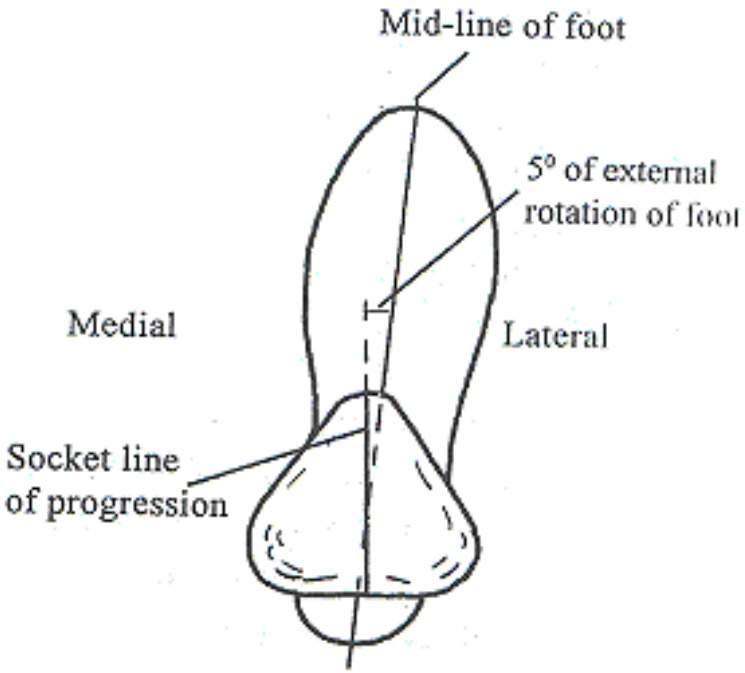
Posterior plumb line

- A plumb line from the center of the posterior wall will fall to the centre of the heel, in ideal case.



Toe out

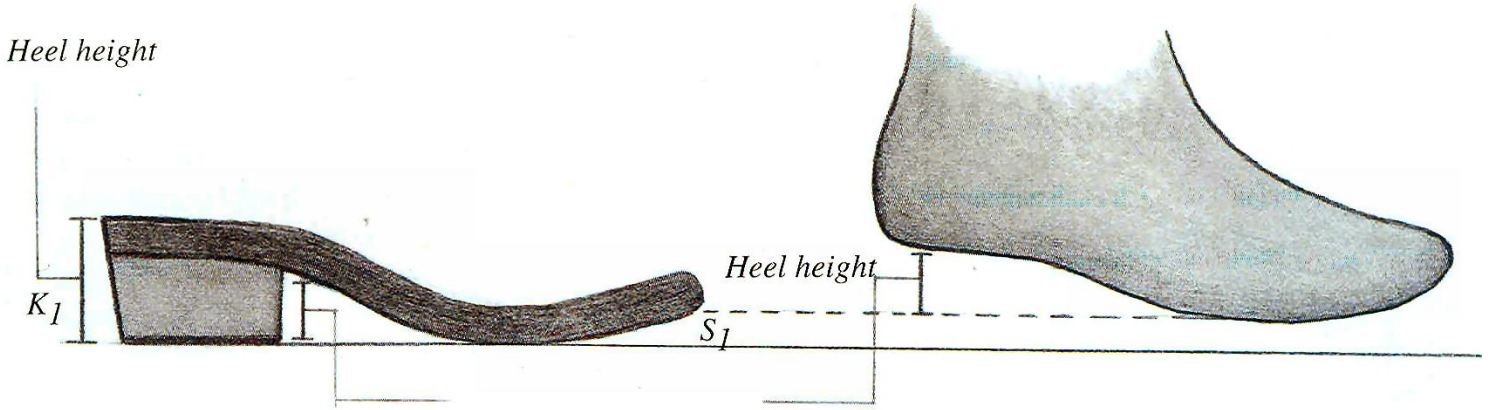
- The toes of the foot are turned out 5° with respect to the line of progression of the socket.
- Top view of foot and socket



Heel height



- Be sure to account for the wearing of shoes when doing the bench alignment.
- Put something under the heel on the prosthetic foot which is the same height as the shoe.



2 STATIC ALIGNMENT

- This should be done before the patient begins to walk on the new prosthesis.

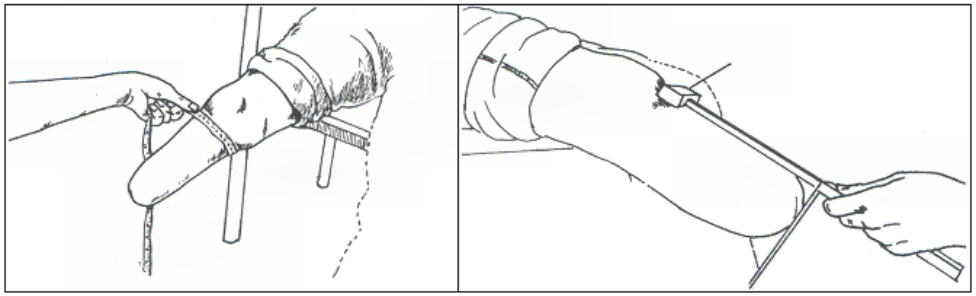
Walking on old prosthesis

- Watch the patient walking on the old prosthesis, if he or she has one.
- This will tell you if there is anything unusual or wrong about the patient's gait habits.
- Look at the sound leg as well, since both legs may be affected by the same problems.



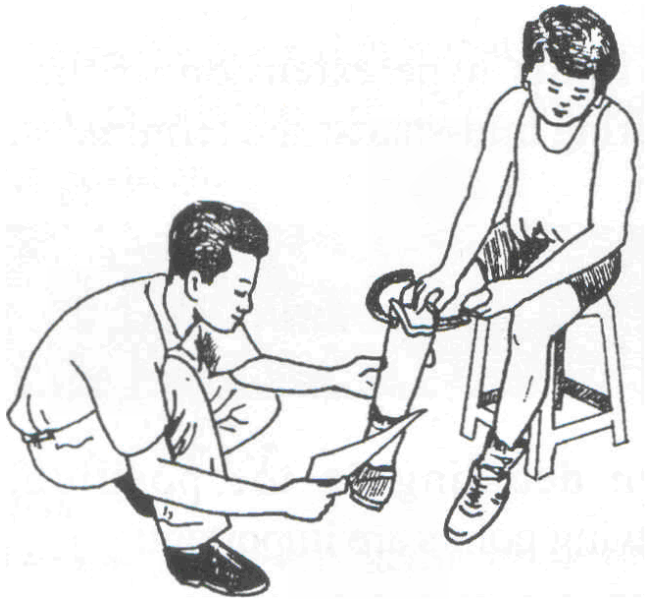
Review the information

- Review the information on the measure chart.
- Check the patient again and make yourself familiar with the problems.



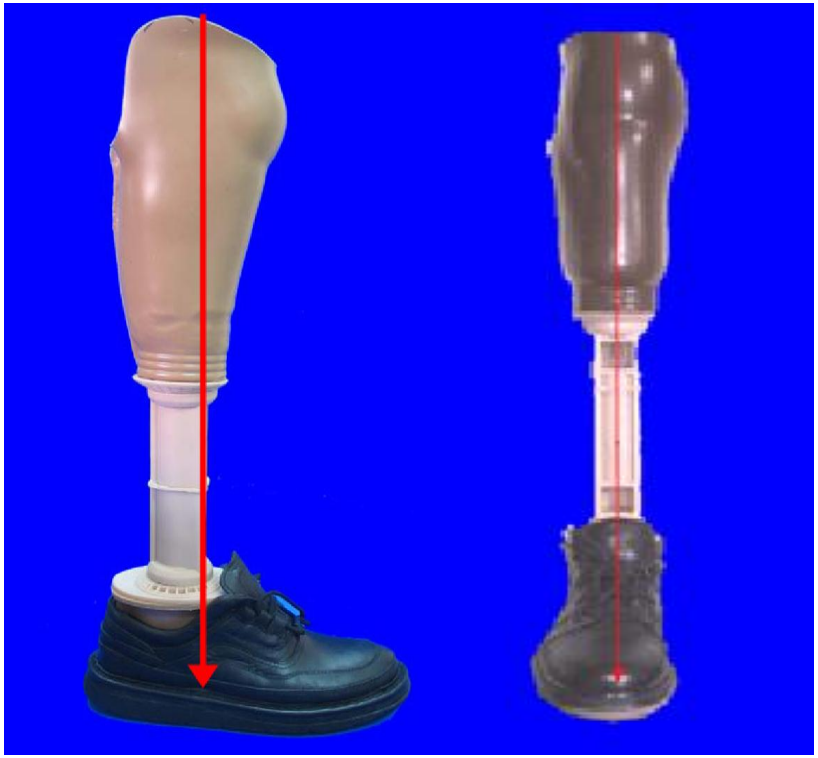
Check prescription

- Check the prescription and see if the leg you have been asked to fit is the same.



Check bench alignment

- Before you start static alignment check the bench alignment to see if it is approximately correct.



Examine the stump

- Examine the patient's stump carefully.
- Note any cuts, abrasions or damage.
- This will help you to work out if the new socket has caused any damage to the stump.
- Check also for signs of swelling (oedema).



Put the stump sock and liner on



- Put on the stump socks and then try the liner.
- It should be a snug fit and the stump should go all the way in easily.
- Put the prosthesis on the patient and check the fit.
- There should be no major gaps at the brim, and the patient should have no discomfort. Adjust or abandon as required

Ask the patient to stand

Check

- Socket fit
- Height of the prosthesis
- Stability of the prosthesis

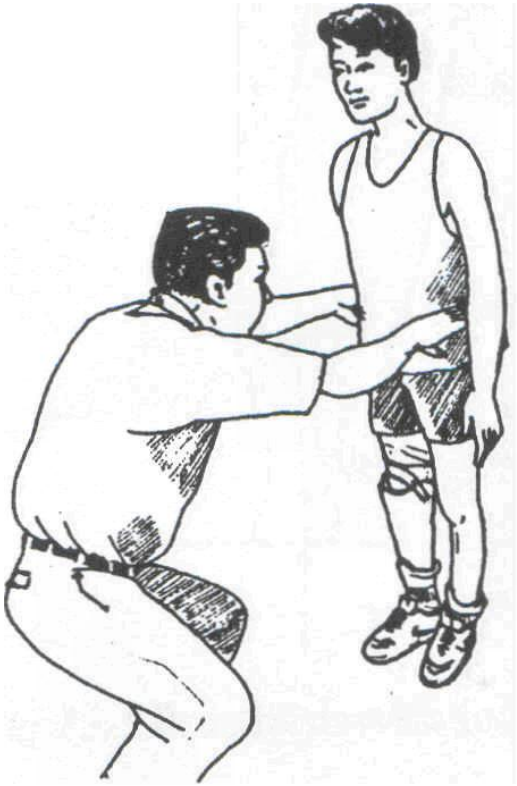


Socket fit

- If there are problems with the socket fit, you must find out why, and correct it.
- If the socket fit is very bad and you cannot correct it, you must stop the fitting and cast the patient again to make correct socket.

Height

- The height of the prosthesis must be correct before you let the patient walk.



Comfort / Stability

- The patient must be able to stand comfortably with the prosthesis without feeling unstable.
- Check if the pole is vertical and if the weight is distributed equally on the toes and the heel.
- If the patient is unstable, you must find out why and correct the problem.
- Never let the patient walk on an unstable prosthesis, as he or she may fall and get hurt.

3 DYNAMIC ALIGNMENT

- When the static alignment is correct it is time for the patient to walk.
- You check the gait if there is anything to correct in the alignment.
- It is best for the patient to walk between the rails until he or she is confident.



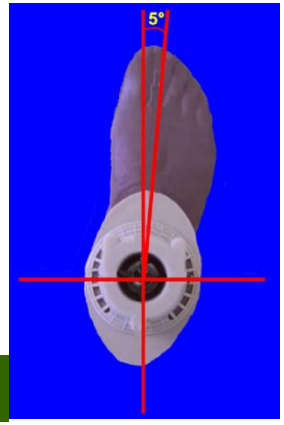
Primary patient

- If this is a primary patient, they will have never walked on a prosthesis.
- Dynamic alignment will have to take place in stages as they learn to walk. This may mean short periods over many days.
- This will require the P&O to work closely with the Physiotherapist (who usually trains the patient in walking).

Non-primary patient

- If the patient has used a prosthesis before, then it may take them a little time to adjust to the new prosthetic alignment.
- **However, do not leave the patient to walk unsupervised!**
- Also bear in mind that some patients will quickly learn to compensate for problems in alignment. This may “hide” problems with your alignment.

Toe out



- Set the “toe out” to closely match the sound foot.

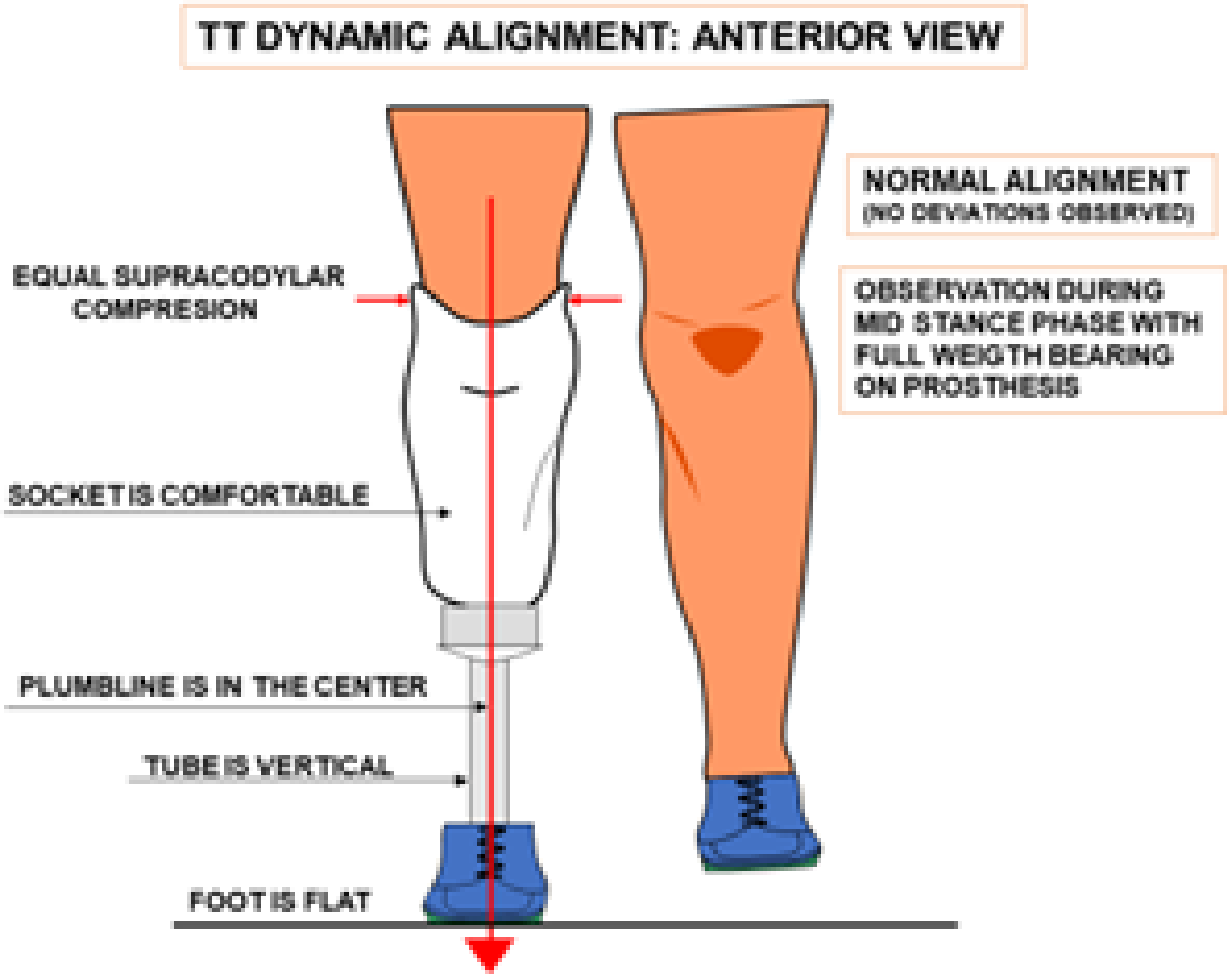


View patient from behind and front

- Assess if the pole is vertical at mid-stance.
- If the pole is not vertical, it means that the patient is walking on either the lateral or medial border of the foot.

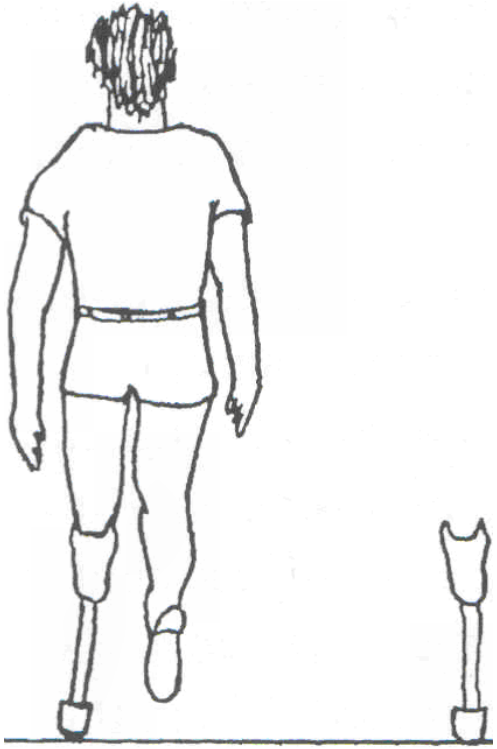


It should look like this

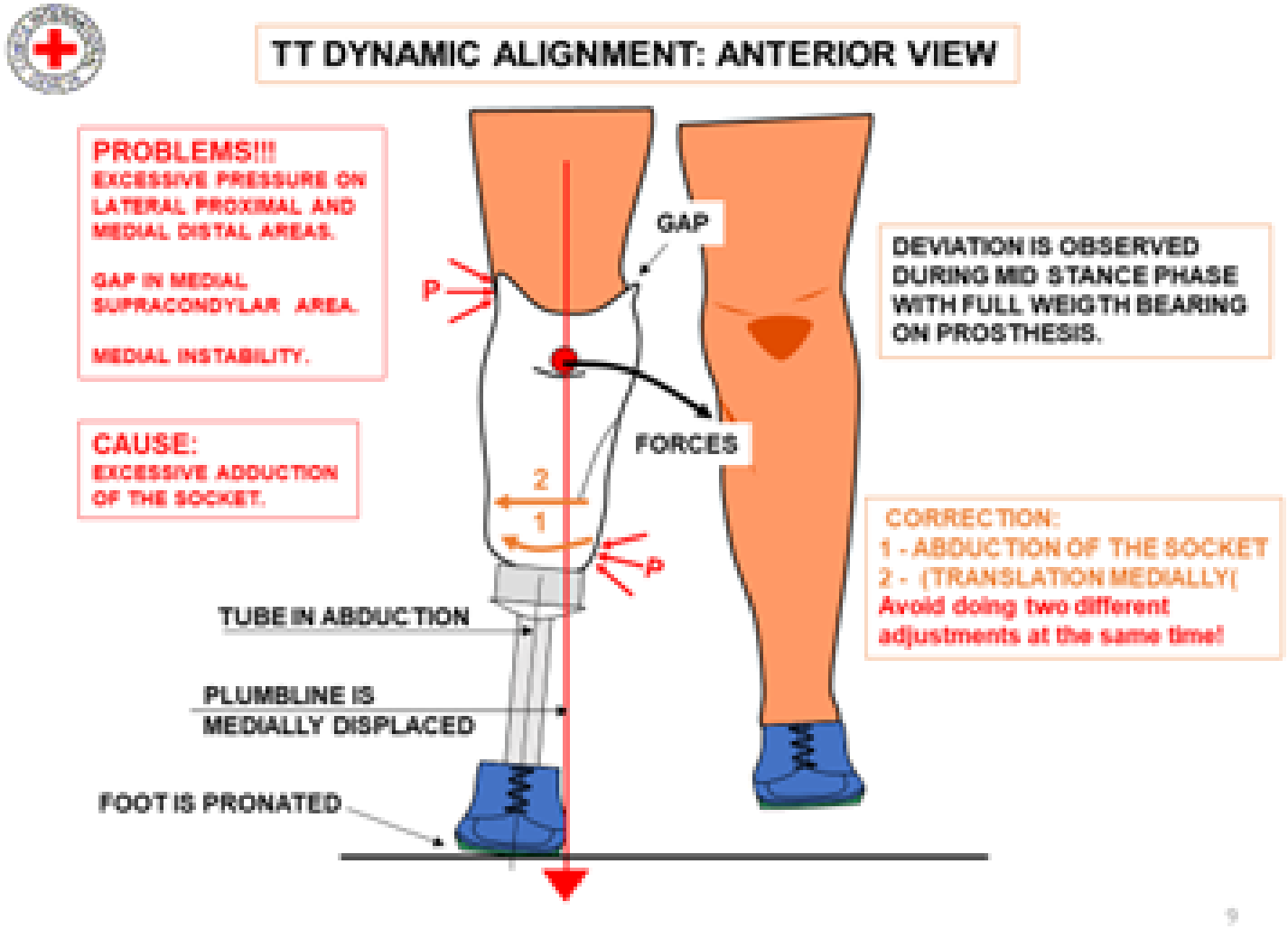


Pole abducted – Socket adducted

- If you see the top of the pole leaning medially, the patient will be walking on the medial border of the foot.
- This means that the socket is placed in too much adduction.
- In order to correct it, you must reduce the socket adduction.

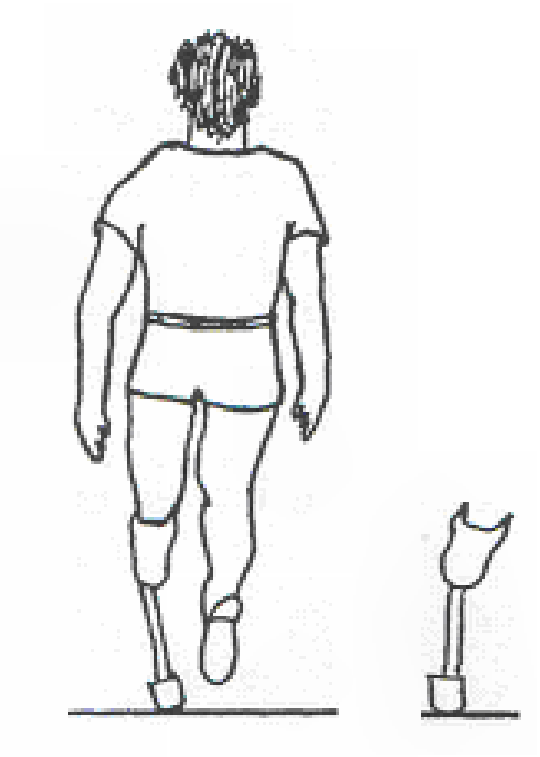


Pole abducted – Socket adducted => Medial thrust

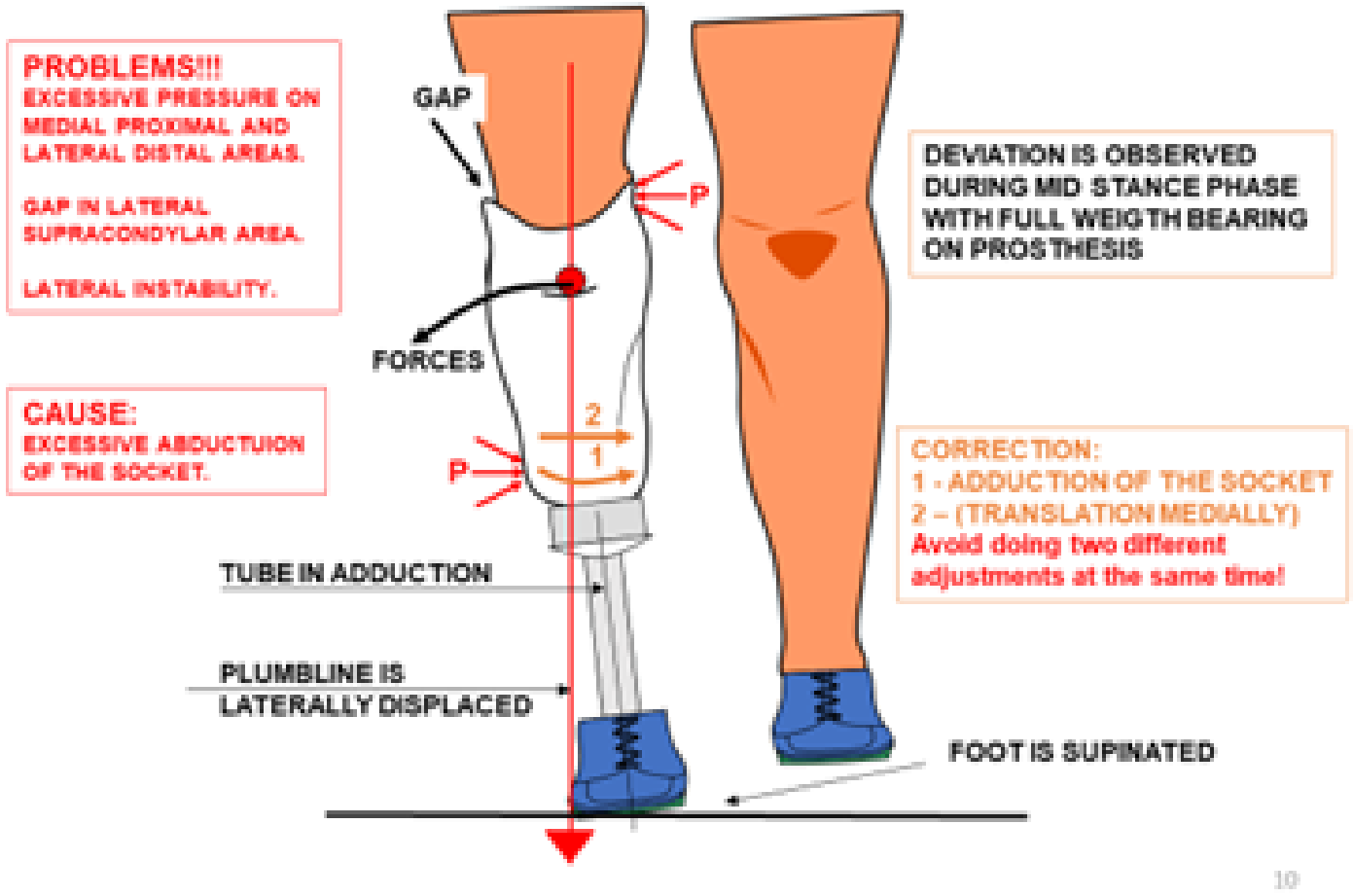


Pole adducted – Socket abducted

- If you see the top of the pole leaning laterally, the patient will be walking on the lateral border of the foot.
- This means that the socket is placed in too much abduction.
- To correct it, you. reduce the abduction (adduct the socket).



Pole adducted – Socket abducted => Lateral thrust



Toe rise at heel strike

- Assess the toe rise at heel strike.
- If the toe rise does not look the same as on the normal foot, it means that the socket is either in too much flexion or in too little flexion.



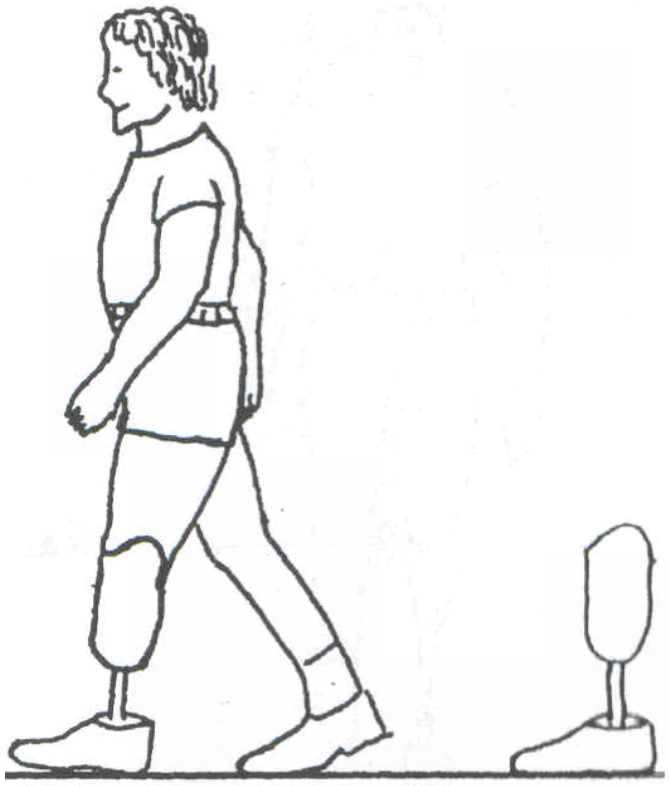
Too much toe rise at HS

- If the toes come up higher than normal at heel strike, it means that the socket is placed in too much flexion
- To correct it, you must reduce the socket flexion.



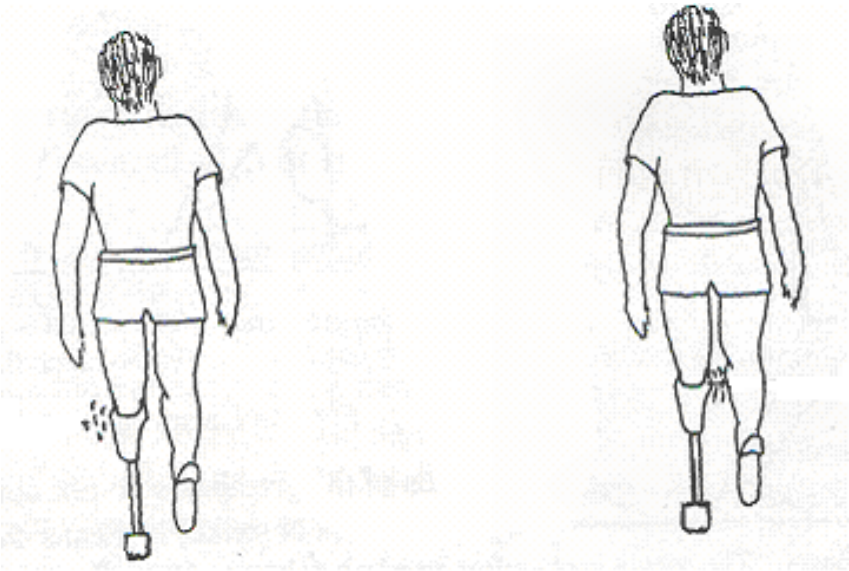
Too little toe rise at HS

- If the toes of the prosthesis do not come up very much at heel strike, it means that the socket is placed in too little flexion.
- To correct it, you must place the socket in more flexion.



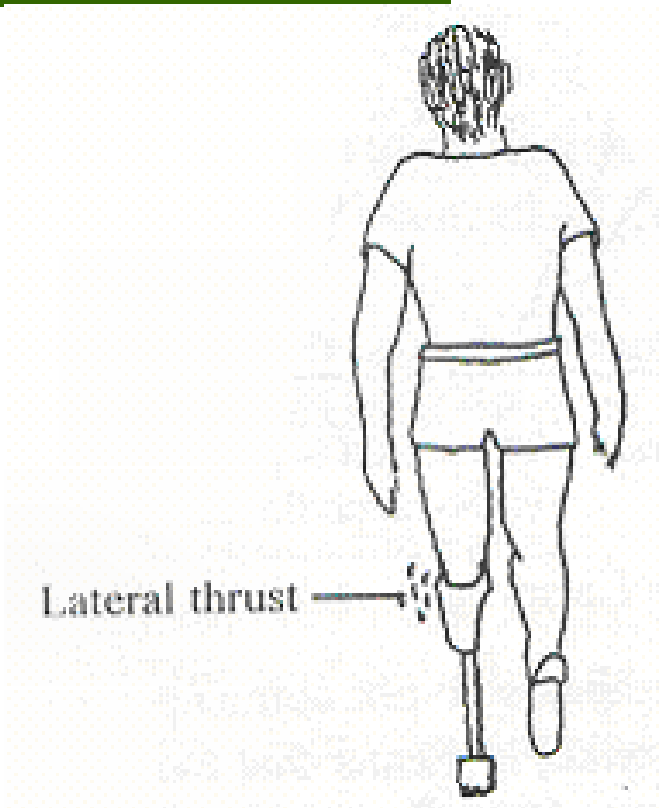
Knee stability at mid-stance

- Watch the knee during mid-stance.
- It should be stable and not move to one side or the other.

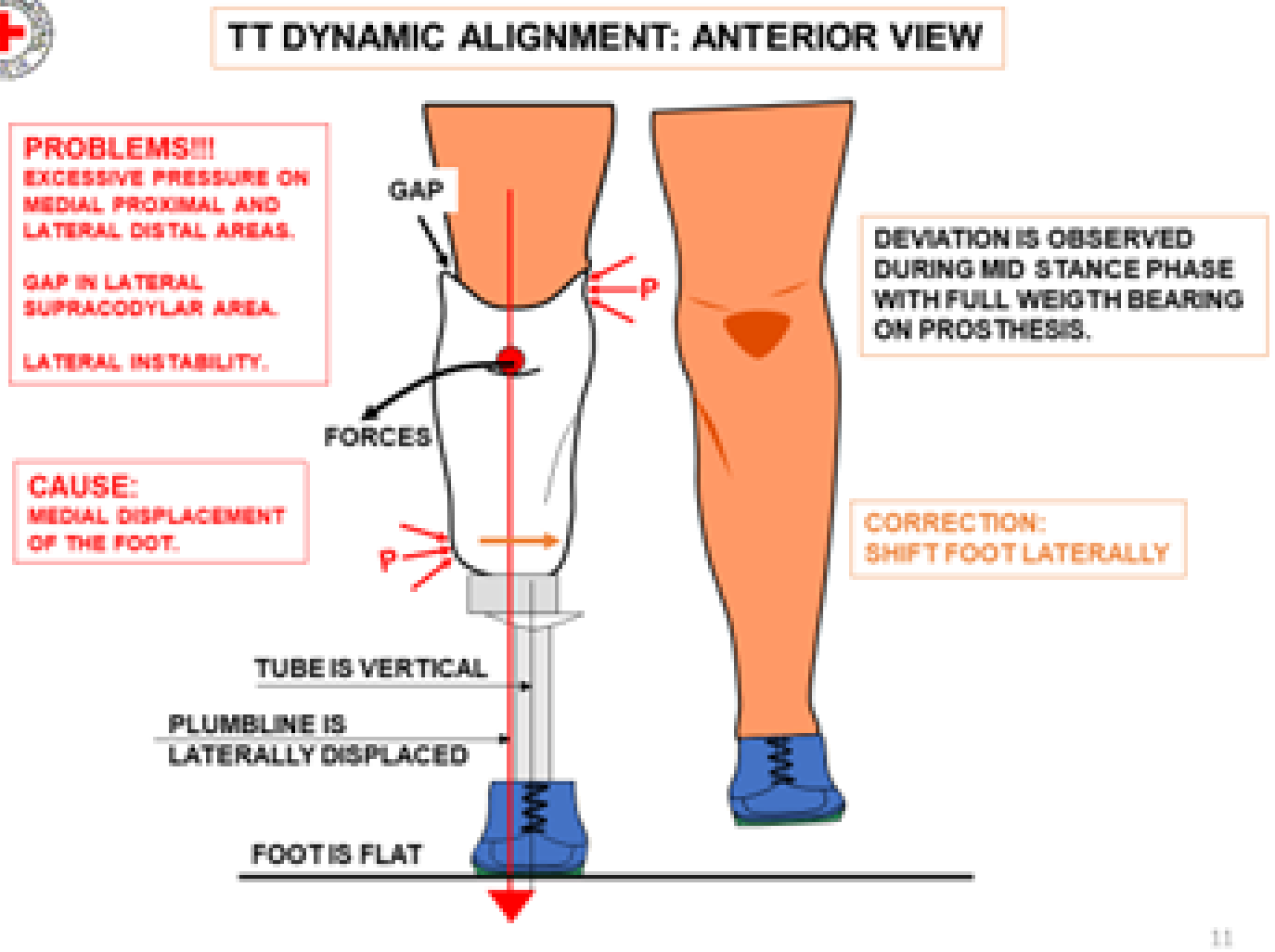


Lateral thrust

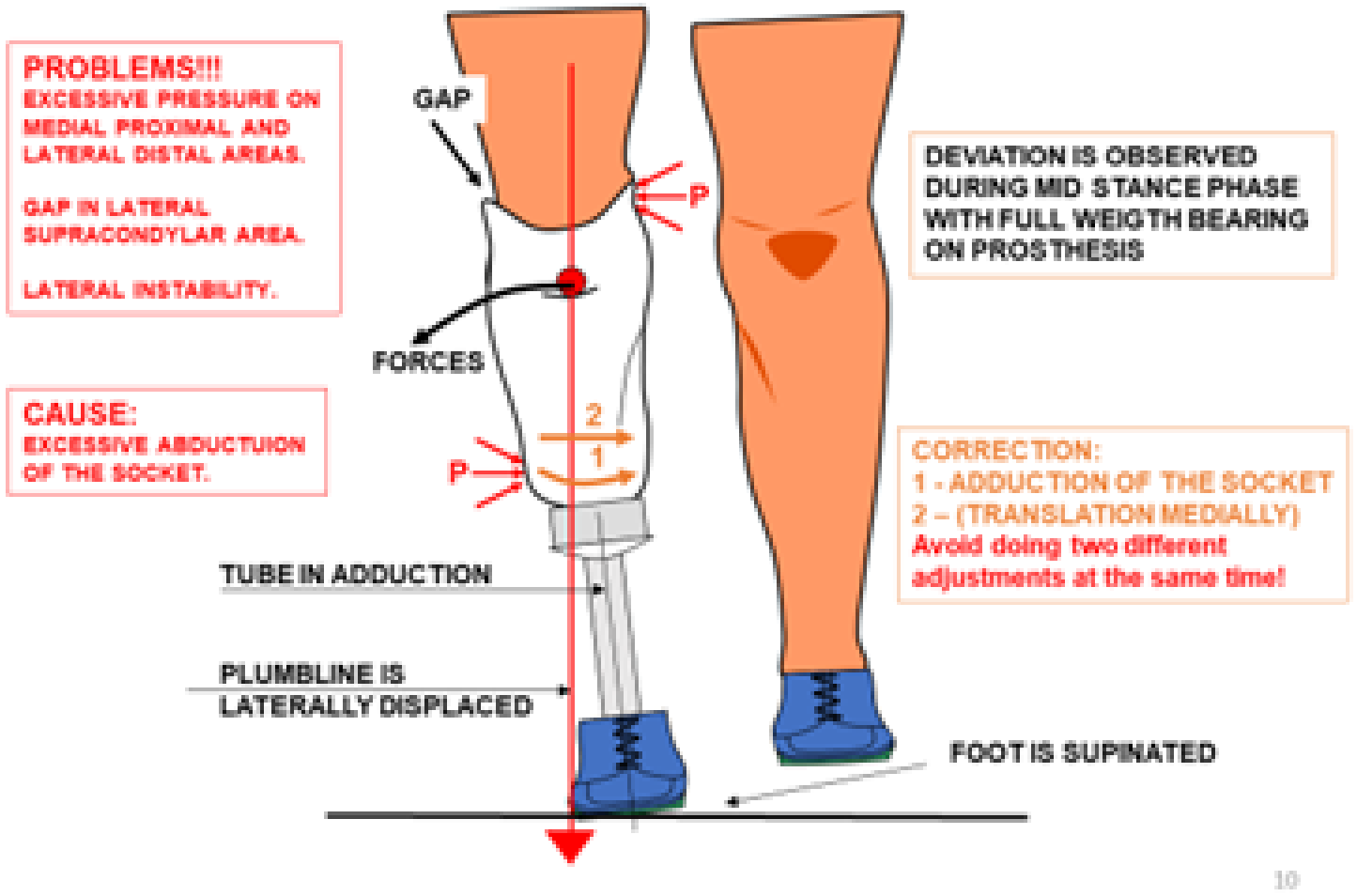
- If the knee jerks toward the lateral during mid-stance, there is lateral thrust of the knee.
- You will probably see that the walking base is quite narrow.
- To correct it, you must slide the foot laterally.



Lateral thrust

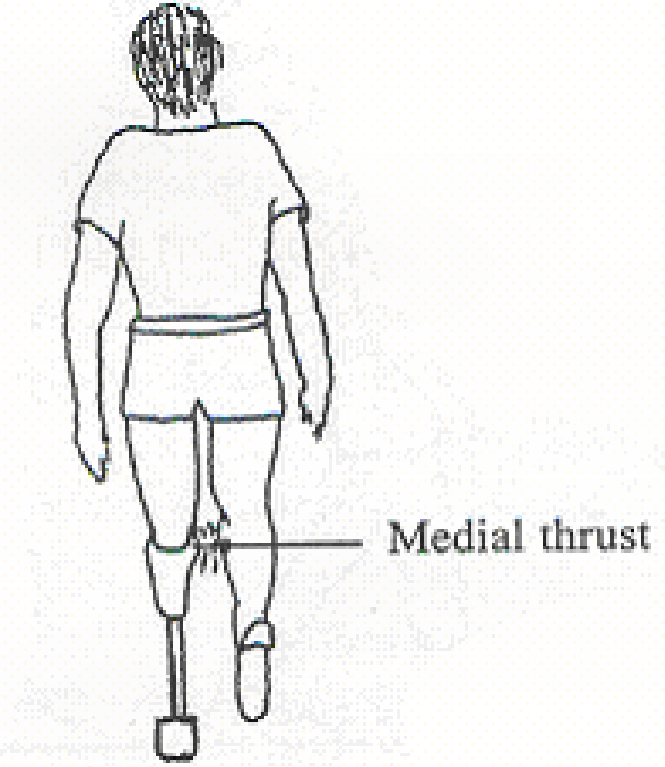


Pole adducted – Socket abducted => Lateral thrust

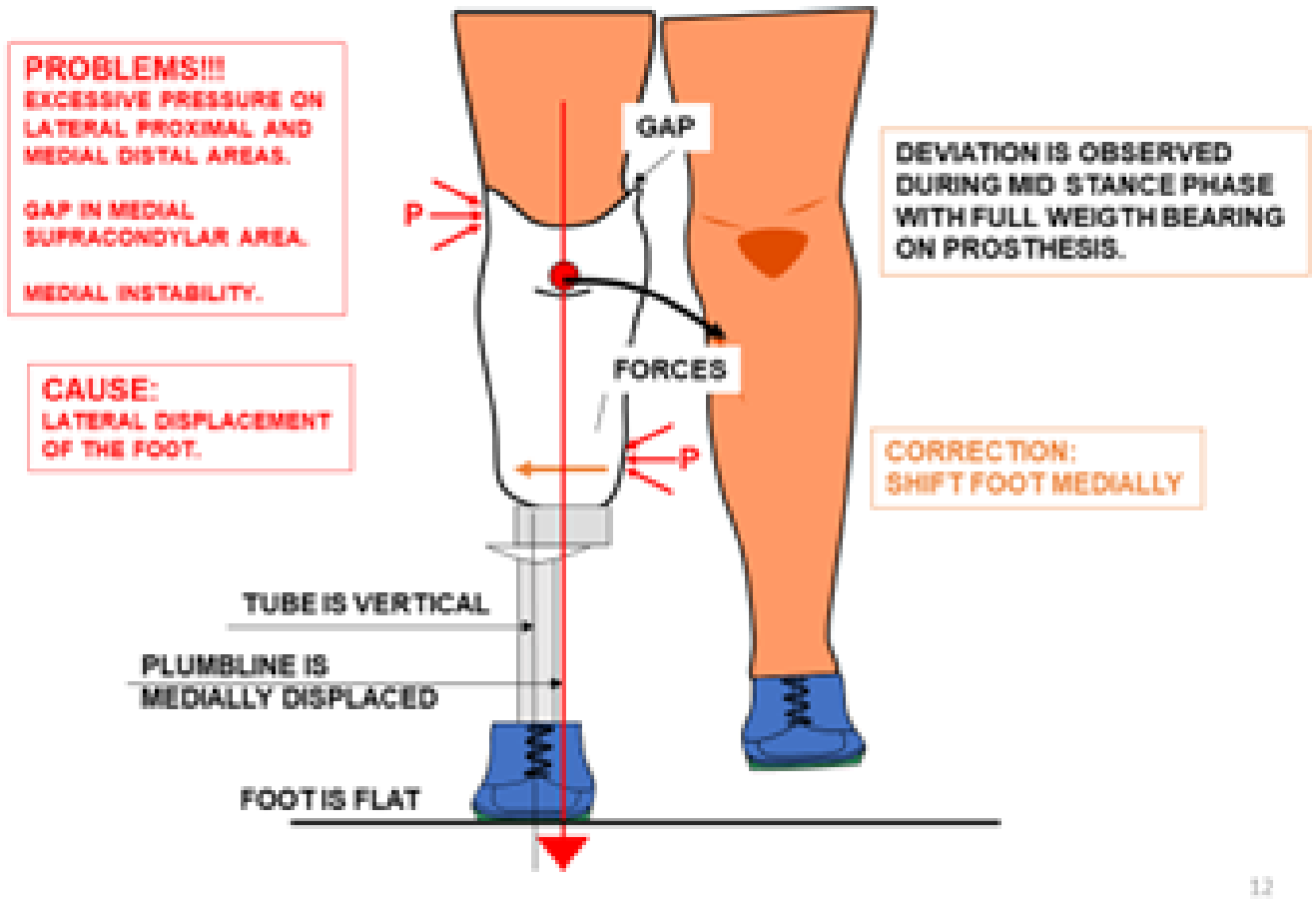


Medial thrust

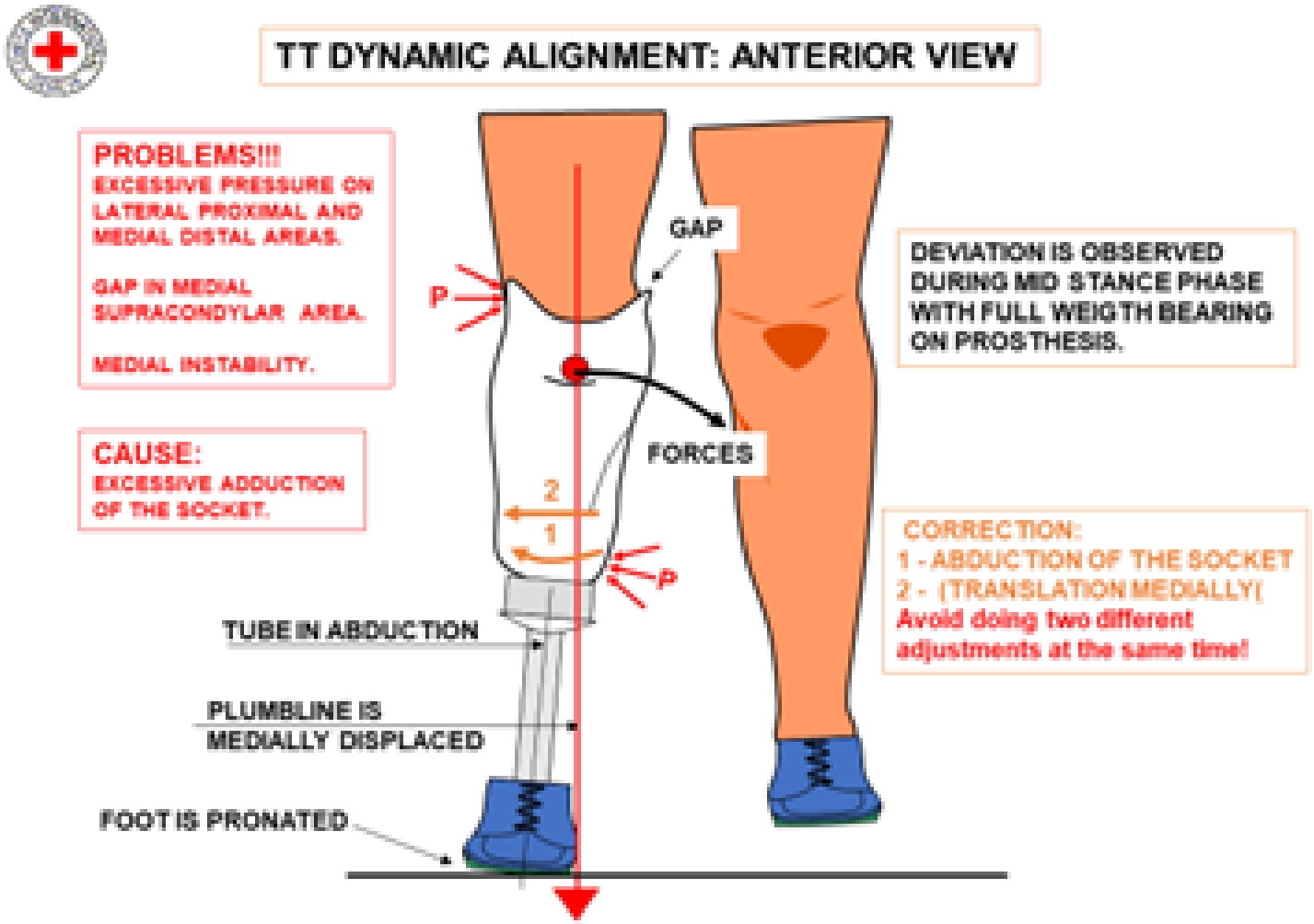
- If the knee jerks towards the medial during mid-stance, there is medial thrust of the knee.
- You will probably see that the walking base is quite wide.
- To correct it, you must slide the foot medially.



Medial thrust



Pole abducted – Socket adducted => Medial thrust



Knee flexion / extension

- Now look at the patient from the side and assess the degree of knee flexion/extension during the stance phase.



Knee too much flexed

- If the knee is flexed more than normal during the stance phase, you must slide the socket posteriorly of correct it

Knee too little flexed

- If the knee is flexed less than normal during the stance phase, you must slide the socket anteriorly to correct it.

Ask patient to carry on walking

- If comfortable, ask patient to carry on walking while you re-check all the factors in the alignment.
- Remember that making one adjustment may change another factor which will then also need to be corrected.

Trim lines and cosmetic cover

- When alignment is correct and the patient is happy, check the for signs of excessive pressure / rubbing.
- When the fit and alignment are good prepare the prosthesis to be finished.
- Check and mark the trim lines and check the cosmetic measures



ALIGNMENT PROCEDURE CHECKLIST

1. Watch the patient walk on the old prosthesis.
2. Check the information on the measure chart.
3. Check the prescription.
4. Check the bench alignment. (Do this is the workshop.)
5. **Examine the patient's stump carefully**.
6. Put on stump sock and liner.
7. Put on new prosthesis.
8. Carry out static alignment.
9. Ask the patient to walk between the rails.

ALIGNMENT PROCEDURE CHECKLIST

10. Look from the front and back – and Check:
    - Toe out position, Pole vertical, Toe rise at heel strike
    - Width of walking base (medio-lateral thrust at knee)
11. Look from the side. Check knee flexion:
12. Check everything again.
13. Check trim lines with the patient sitting.
14. Take the prosthesis off and check the stump.
15. Check the measures for a cosmetic finish.

Thank you