



NEGATIVE PLASTER CASTING: COMMON ERRORS AND RESULTING CONSEQUENCES BY: CHRISTOPHER L. MACLEAN, PH.D.

An accurate negative cast is the first and most important factor for achieving desired therapeutic goals using custom foot orthotic therapy. Creating an accurate three-dimensional negative model of the foot and taking the time to evaluate that cast is critical to successful outcomes. In computer science and mathematics, there is a principal known as GIGO. This acronym stands for "garbage in-garbage out" and this concept can be applied to what occurs when an inaccurate negative cast is sent to the lab. Over the past 30 years, we have had an opportunity to identify the most common casting errors that typically occur. In this Industry Bulletin, we will review the most common casting errors and explain the consequences that occur in the final product.

1. DORSIFLEXED FIRST METATARSOPHALANGEAL JOINT (MTPJ):

This error can occur when: 1) the plaster is wrapped too tightly; 2) the patient is actively contracting their extensors during the casting procedure; and/ or 3) when the first ray is appropriately plantar flexed during casting. When this error occurs, the resulting negative cast will present with a false increased medial longitudinal arch (MLA) height and/or a false forefoot valgus alignment (Figure 1).

2. MLA DROPOUT:

MLA dropout is a term we use to describe when the plaster gauze is relaxed off of anatomy in the area of the MLA during the application of plaster and/or during the drying process (Figure 2). Similar to the first example, this can occur when plaster is wrapped around the foot too tightly and/or if the first MTPJ is in a dorsiflexed position during casting. Also, if time is not taken to massage plaster into the MLA to ensure a total contact interface, MLA dropout will result in the negative cast. The resulting orthotic device will have decreased arch height and the orthotic shell will be relaxed off of anatomy.



Figure 1



Figure 2



3. INCORRECT THUMB POSITIONING:

When casting the patient supine or prone, we recommend that the thumb is positioned in the sulcus of the fourth and fifth. An error of improper positioning can occur with placing the thumb too far medial in the sulcus or inferior to the metatarsal heads (Figure 3). The result of this error is that it often produces a false metatarsus adductus (Figure 4). That is, the forefoot becomes adducted relative to the midfoot/hindfoot. If you must position the thumb under the metatarsal heads for a better grip, please ensure that you push/punch out the impression prior to shipping. Practitioners often find it difficult to grip the wet plaster with latex gloves. This can be remedied by using a small swatch of dry plaster gauze to improve grip traction and prevent thumb slippage.

4. INADEQUATE LOCKING OF THE MIDTARSAL JOINT (MTPJ):

This casting error typically occurs when there is insufficient dorsiflexion of the ankle joint during casting. It can be caused by: 1) soft tissue or osseous equinus; 2) incorrect casting position; and/or 3) decreased midtarsal and/or subtalar joint range of motion. When this occurs, the foot tends to be in a supinated position and the resulting orthotic device will inherently have an increased MLA profile and lateral longitudinal arch (LLA) height. Additionally, the negative cast may also result with a false plantar flexion of the forefoot with respect to the rearfoot.

5. OVERPRONATED CAST POSITION:

When the practitioner excessively loads under the lateral column during casting the subtalar joint can be forced into a pronated position. This can occur: 1) by inaccurate positioning of the subtalar joint in neutral; 2) with a hypermobile foot type; and/or 3) by pressing too aggressively on the lateral column of the foot while the plaster is setting. This error results in a forefoot that is falsely abducted relative to the rearfoot, a decreased MLA arch height and/or a false forefoot valgus alignment in the negative cast.





Figure 3

Figure 4

6. SUPINATED CAST POSITION:

This casting error results in a false, adduction of the forefoot relative to the rearfoot (Figure 4). It typically occurs when the practitioner is incorrectly positioned with a faulty hand position and/or casting arm position. We have recommended the thumb position above in Section 3. When casting supine we also recommend that the casting forearm is parallel to the ground and that the elbow is up. This error can also occur by an excessive plantar flexion of the first ray when reducing supinatus and/or when applying an inappropriate adduction force to the forefoot while casting. The result of this error is that the forefoot will have a false forefoot adductus, a false increased MLA height and a supinated midtarsal joint.

7. FAILURE TO REDUCE FOREFOOT SUPINATUS:

This error occurs when a practitioner fails to reduce supinatus or applies insufficient plantar flexion to the medial column soft tissue to balance the 1st through 5th MTPJ. The downward force should be applied to the area of the first metatarsal shaft and medial cuneiform. Failure to reduce forefoot supinatus will result in a negative impression that has a false forefoot varus and/or a decreased MLA arch height.



8. FAILURE TO EVALUATE CASTS:

The above-mentioned errors should be kept in mind when evaluating casts, prior to shipping. As a practitioner, you want to ensure that you have accurately captured the three-dimensional shape of the patient's feet while positioned in subtalar joint neutral and with the midtarsal joint locked. Although it takes time to recast and correct a casting error, the long-term benefit greatly outweighs the time and cost of dispensing an orthotic device that will likely be intolerable and/or a device that will not produce a positive clinical outcome.

The keys to evaluating your negative casts involve first ensuring that the casts accurately reflect and match your evaluation. If there is no noticeable asymmetry between left and right sides, you will want to ensure that you have accurately captured:

- 1) The first MTPJ angle in the sagittal plane;
- 2) The forefoot to rear foot relationship in all three planes;
- 3) Symmetrical distances from heel center to:1) the fifth MTPJ; and 2) the first MTPJ.

In the figures below, (Figure 5) the image on the left depicts a potential casting error (assuming the feet are symmetrical). In this case, the distance from heel center to 1st MTPJ in lesser for the left foot. This left cast could, potentially, have a false forefoot adductus as would occur with improper thumb positioning or supinated cast error.



9. SHIPPING ERRORS

Unfortunately, you can capture perfect negative impressions but if the casts are not dried and/or shipped correctly damage can occur, in transit (Figure 6). The more common errors we experience involve when the casts are not allowed ample time to dry with the lack the structural integrity for shipping and fabrication. This can occur when not allowing casts proper drying or curing time before putting in the shipping box, insufficient layering of plaster gauze when taking the cast, and/or insufficient milking of wet plaster into gauze material before putting the gauze on the foot. Also, casts should not be packed with paper or foam. This tends to keep the moisture in and can jeopardize the drying process. Lastly, each cast should be clearly identified with the patient's name written on the plantar surface so that when it arrives at the lab it can be properly identified throughout the manufacturing process.



Figure 6

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Figure 5