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# Comparison of "Custom-Made" Stack's Splint and "Home-Made" Dorsal Tile Splint: Clinical Case Reports

**Denis Gerlac***

*Physiotherapist, Echirolles, France*

***Corresponding author:** Denis Gerlac, Physiotherapist, 5 avenue Docteur Calmette, Echirolles, France, Tel: +33476455875; E-mail: denis.gerlac@yahoo.com

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## Abstract

**Introduction:** During the period of immobilization of mallet-fractures treated in an orthopedic way, there is sometimes a harmful secondary displacement of the distal fragment.

**Method:** At present the splints mostly used to stabilize and immobilize the seats of these fractures, depending on opinions, are either homemade dorsal tiles or Stack splints.

We have chosen to use the "custom-made" Stack's splint.

**Result:** The final assessment has been carried out after six months. We found no secondary displacement. The recovered mobility is excellent. The results are excellent according to the standardized criteria.

**Discussion:** In this presentation we explain why we preferred to use, for these two mallet-fractures, a "custom-made" Stack's splint rather than a dorsal tile.

The main advantage of the "custom-made" Stack is the presence of a counter surface under the Distal-Inter-Phalanx (DIP). It decreases the risk of the distal fragment of the ungueal phalanx sliding down especially if we perform, to reduce the fracture, an upward push under the distal extremity of the distal fragment. This counter surface seems to us important to counteract, throughout the treatment, against volar sliding.

**Conclusion:** Both splints have the same function: to stabilize the extremity of the finger. Their modes of action are very similar they use holds and counter-holds to immobilize the extremity of the finger. On the other hand the "custom-made" Stack's splint has the advantage that the dorsal tile does not have: a counter-hold placed under the seat of the fracture. For this reason we recommend using a "custom-made" Stack's splint in spite of its drawbacks (maceration and occlusion of the pulp).

**Keywords:** Mallet finger; Mallet fracture; Splint; Stack; Dorsal tile

## Introduction

Although Robb [1] wrote in 1959 about the treatment of mallet fingers: "a satisfactory state of recovery will occur in practically all cases of mallet finger even if no treatment is given", nowadays the usual treatment of mallet fractures, closed and not displaced, is primarily orthopedic [2-4] and is based on the use of a splint providing complete immobilization throughout a minimum period of 45 days [2,4-6].

However, it is not rare to observe that during the phase of immobilization a secondary displacement of the distal fragment occurs (Figure 1). Furthermore, the sliding always follows the same palmar direction.

We are therefore entitled to assume that the responsibility of that secondary displacement of the distal fragment, lies with the Flexor Digitorum Profondus (FDP) traction which is not counterbalanced by that of the Extensor Digitorum Communis (EDC), but we believe that if the fracture is stable to start with, and especially if it is perfectly stabilized by a splint, it should not move.

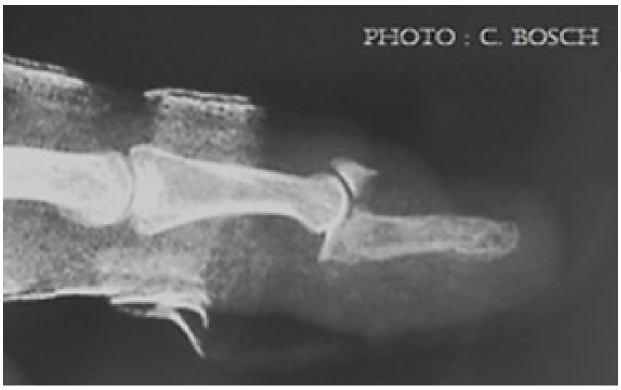


**Figure 1:** Mallet-fracture presenting a secondary displacement.

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## Methods

### Dorsal tile versus "custom-made" stack splint

The splints most usually prescribed for this pathology are custom-made splints. When we have the choice, their use is to be preferred to a factory orthoses [5,7], because, factory orthoses are rarely the right size [7].

Although many orthoses described to immobilize this type of fracture exist, it appears that two types of splints are usually used, on the one hand the dorsal tile (Figure 2) and on the other hand the orthosis in the shape of a hoof, described by Hugh Graham Stack (Figure 3) [8-11].


**Figure 2:** Sticked dorsal tile.


**Figure 3:** "Custom-made" Stack.

The orthosis in the shape of a tile and the "custom-made" Stack's splint are of fundamentally different designs. The first one is dorsal and held in place by means of adhesive tapes and glue, the second one is circular and does not require an additive to stay in place. They both have advantages and drawbacks. The Stack's splint is criticized for concealing the pulp of the ungueal phalanx and the adhesive tile is accused of peeling off. Moreover, both splints, can be the source of maceration and ulceration [5,6,8,9]. These last two complications, which can jeopardize the quality of the result, are not created by the orthosis itself, but rather in the compliancy and respect of the treatment (sometimes long) by the patient [4]. However, the action mode of these two splints is identical: both work by using supports and counter supports to stabilize the seat of the fracture. A priori, both splints correspond to the criteria for the treatment of this pathology. They are recognized as reliable and thus commendable.

### The advantages of the "custom-made" stack splint

When we study more closely the biomechanics of these two splints, we notice that the tile can present weaknesses, in particular within the framework of the treatment of the mallet-fractures. The location of supports and counter supports as well as the size of surfaces touching the finger differ considerably from one splint to another. This creates doubts about the tile. The "custom-made" Stack's splint which is circular, has wide holds and counter holds which thus totally maintain the fracture's seat, in particular at the level of the volar region of the DIP (Figure 4a).

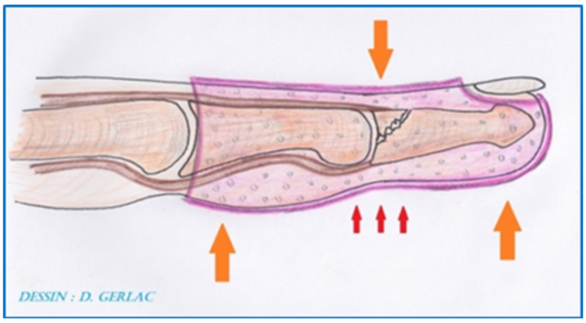


**Figure 4a:** "Custom-made" Stack Splint. Holds and counter-holds allow to place the DIP in
Red arrows show the volar counter-hold offered by the "custom-made" Stack's splint and counteracts the volar displacement of the distal fragment.

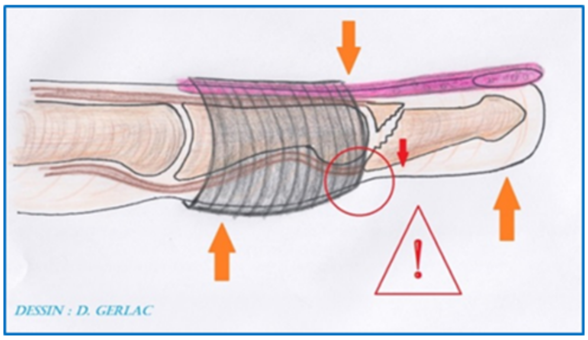


**Figure 4b:** Dorsal tile. Holds and counter-holds maintain the DIP in extension position (yellow arrows).

The red arrow shows the volar displacement of the distal fragment due to the absence of a counter-hold below the DIP.

The tile, being less "constrictive", has narrower and less precise surfaces of support as far as their locations are concerned. The consequence is that if these supports are not placed in the right places and, moreover, if they have too important leverage, they can create a large shearing force at the level of the fracture's seat and so, rather than stabilize it, are going to lead to its displacement (Figure 4b). Furthermore, once the displacement has begun, it can be increased by the energy of the FDP.


**Figure 4c:** "Bottle-opener" effect that the dorsal tile or the "factory" Stack's splint can generate.

The upward traction under the nail added to a dorsal counter-hold placed on the DIP can create a volar displacement of the distal fragment. These are the arguments which dictated our choice of a "custom-made" Stack's splint rather than a dorsal tile to treat both cases of mallet-fractures that we present here. We consider the "custom-made" Stack's splints which do not have a notch below the volar part of the DIP joint (Figure 4c).

Because, if there is a notch under the DIP joint, as is the case in the readymade Stack's splints (Figure 4d), we would be in the presence of the same defects as that of the dorsal tile. Given its initial shape which places the DIP in light extension, it has the profile of the "perfect bottle-opener" when its dorsal part is pressed on the back of the penultimate phalanx.


**Figure 4d:** "Factory" Stack whose mechanical principle can act on one mallet-fracture as that of the bottle-opener.

## Results

Here are the cases of two patients that we treated. They both had the same type of treatment.

**Case number 1:** A 32-year-old woman, left-handed, presenting one mallet-fracture of the left ring finger (Figure 5a) which happened during a basketball match.

For that patient, we made a "custom-made" Stack's splint the D+2 (Figure 5b). To reduce the fracture as much as possible, that is to eliminate the diastasis between both fragments, we had to position the DIP in light extension. An X-ray control was made after the fabrication of the orthosis to verify the good redressal of the fracture. Then, two other X-ray controls were performed in the following two weeks (one X-ray a week) to follow the evolution and prevent a possible secondary displacement. This patient kept the "custom-made" Stack's splint for 49 days, after which she had a new follow-up visit with a new X-ray which confirmed the consolidation.

At the release of the splint, the DIP's active mobility of the ring finger measured during a demand of global motion of fingers, in flexion and extension, was : Flexion/Extension of DIP=25°/10°. This patient did not have any re-education session. She was seen in consultation again one month after the removal of the splint. The DIP's active mobility of the ring finger measured during a demand of global motion of fingers, in flexion and extension, was: Flexion/Extension of DIP=60°/5°. A new control of the mobility was made after D+6 months. The mobility was still just as good. Active Flexion/Extension of DIP=70°/5° (Figure 7a and 7b).

**Case number 2:** A 26-year-old man, right-handed, presenting one mallet-fracture of the right thumb (Figure 6a) which happened when he fell off his bike during a down-hill bike race. A "custom-made" Stack's splint was made for this patient the D+2 (Figure 6b). To reduce as much as possible the fracture, that is to eliminate the diastasis between the two fragments, we had to position the DIP in hyperextension, taking care to push precisely under the P2's base (and not under the distal extremity of P2), to move closer both fragments of P2.

X-ray control was made just after the making of the orthosis to verify the good rectification of the fracture. Then, two other X-ray controls were performed in the next two weeks (one X-ray a week) to follow the evolution and prevent a possible secondary displacement. This patient wore the "custom-made" Stack's splint for 47 days, after which he had a new follow-up visit with a new X-ray which confirmed the consolidation.

At the release of the splint, the IP's active mobility of the thumb measured during a demand of global motion, in flexion and extension, was: Flexion/Extension of IP=10°/30°. This patient did not need any re-education. He was seen in consultation again one month after the removal of the splint. The IP's active mobility of the thumb measured during a demand of global motion of the thumb, in flexion and extension, was: Flexion/Extension of DIP=45°/30°. A last control of the mobility was made after D+6 months. The mobility was still as good. Active Flexion/Extension of the IP=50°/30° (Figure 8a and 8b). The assessment of our results was made using the criteria of Abouna et al. [12], Crawford [13] and Patel et al. [14].

The results we obtained for our two patients, according to these criteria, are excellent because the mobility recovered in extension is complete and the flexion is normal (Figure 7a, 7b, 8a and 8b). Furthermore, both patients did not present sensibility disorders

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associated with the pulp occlusion created by the port of the splint, one of the weak points often attributed to Stack's splint [15].

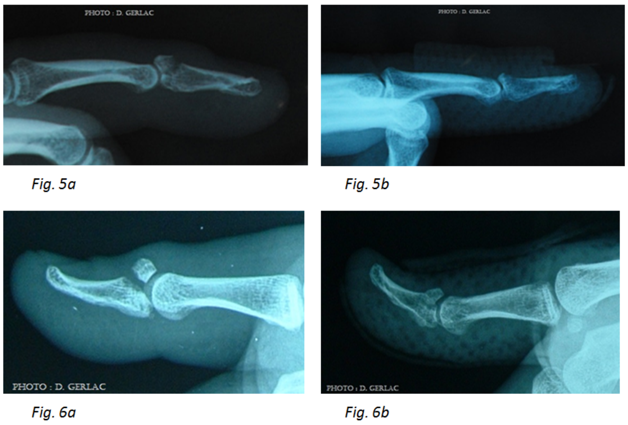


**Figure 5a, 5b, 6a and 6b:** Two examples of mallet-fracture (ring finger 5a, 5b and thumb 6a, 6b) reduced by placing the DIP in extension position and immobilized with a "custom-made" Stack's splint.

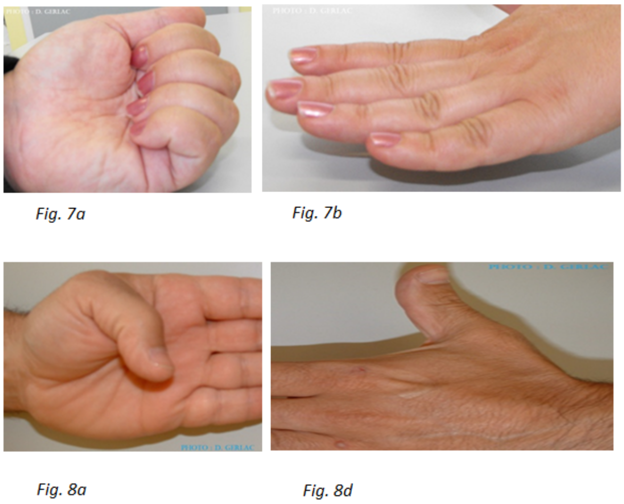


**Figure 7a, 7b, 8a and 8b:** Mobility results after consolidation. Up-side (7a and 7b), ring finger of Figure 5a and 5b. Left-side (8a and 8b), thumb of Figure 6a and 6b.

## Discussion

Contrary to tendinous mallet fingers the orthopaedic treatment of osseous mallets has a peculiarity which can complicate the use of a dorsal splint. Osseous mallets need a slightly more pronounced extension of the DIP in order to reduce the diastasis provoked by the traction of the extensor tendon on the proximal fragment. Thus, if there is no counter-hold placed under the DIP, the risk of displacement of the distal fragment is important. If they are badly placed, holds and counter-holds of the tile might have the same effect as that of a bottle-opener. They are going to push the distal fragment downwards (Figure 4c). This leads some authors to write "The putting into extension has tendency to move the fracture and to increase the articular incongruence" [2].

Moreover, this displacement can be increased by the traction of the FDP. The pictures of the two patients, shown here (figure 5a, 5b, 6a and 6b) reinforce the idea that contrary to first ideas [2], the hyper-extension of the DIP does not generate secondary displacement if it is controlled by one volar counter-hold.

Furthermore, the putting into extension of the DIP which generates, it is true, a momentary bleaching of the dorsal skin of the DIP did not provoke the necrosis which is often associated with the supposed devascularization [2,6], nor delay the consolidation.

## Conclusion

The result of this work is based on only two cases. It is therefore difficult to draw an objective conclusion.

However we can use an image to explain our choice of using a "custom-made" Stack's splint rather than a "home-made" dorsal tile splint to stabilize the osseous mallet.

If we compare a mallet fracture, which is potentially unstable, with trousers just a little too big at the waist using a Stack's splint seems to be the same as using both a belt and a pair of braces to hold the trousers up. It is obvious that with two safeties rather than one, the chance of keeping the trousers up increases. It is the same for the stability of the fracture.

The Stack's splint just like the dorsal tile, acts as a guardian and both maintains and stabilizes the finger in rectitude position. Likewise, the "custom-made" Stack's splint also stabilizes the seat of the fracture with a volar counter-hold under the DIP joint.

That is the reason why we recommend using a "custom-made" Stack's splint in spite of its drawbacks (maceration and occlusion of the pulp).

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