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Hafting tests on tanged blanks

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We used this protocol and it's working

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Abstract

By the end of the Middle Pleistocene and the beginning of the Late Pleistocene (around 150,000 - 130,000 years ago), the Middle Stone Age in North Africa witnessed the emergence of tang technology. This innovation is characterized as a technical solution that facilitates hafting. Moreover, this technical behavior was consistently represented as point technology. This notion leads to the assumption that the tang was used for hafting in an axial orientation, with the tang being inserted into another material like wood or bone. However, what about the rest of the artifacts? What if the tang was not inserted but used for fixation instead?

In our experimental work, we explored alternative hafting methods where the tang was not inserted but used for fixation. These methods involved testing two hafting systems: the juxtaposition of the tanged artifacts onto wooden sticks, and the insertion of one edge adjacent to the tang. The choice of hafting systems was motivated by the thickness distribution of the produced convergent artifacts.

After hafting, we tested the functionality of these artifacts through three main activities: throwing the spear points, using the spears for penetration, and conducting butchering activities. The first two activities were tested on a simulation of animal carcasses using a mixture of gelatin and pig bones (two scapulae and two radius ulnae), while the butchering activities were conducted on fresh pig limbs.



Materials

- lithic raw material (ideally flint)
- wooden sticks
- knife
- animal resin
- gelatine
- vegetal fibre
- water
- hotplate
- cooking pot
- gloves
- animal bones (scapulae, radius ulnae)
- mould of big dimensions (46*31 cm)
- dinolite

Troubleshooting

1) Animal resin preparation : here is the followed recipe

- 1 Purify the water by boiling it, then let it cool down.
- 2 Put twice as much water than resin, then let it sit for 24 hours.
- 3 The next morning, heat the mixture using a bain marie, without going over 60°.



Animal resin and water heated at 60°

2) Gelatine tests : 4 different test were made to find out which is best for the fake carcass

4 1st test

450ml of water for 50g of gelatine : **success.**



Two gelatine tests



Packs of gelatine used in the experimentation

5

2nd test :

350ml of water for 50g of gelatine : **success.**



Flake stuck inside the finished gelatine

- 6 **3rd test :**
400ml of water for 50g of gelatine : **success.**
- 7 **4rth test :**
450ml of distilled water for 50g of gelatine : **success.**

3) Gelatine preparation



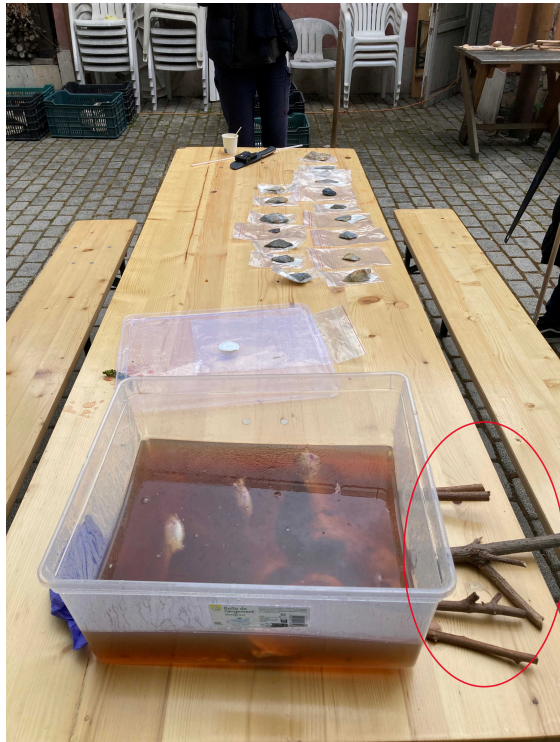
8 We opted for 5L of water for 730g of gelatine.

9 Bones disposal inside of the future block of gelatine.



The bones are disposed in the mould

10 We wedged the sitting gelatine so that it covered the scapulae.



The wedge is circled in red

- 11 Let it sit for 24 hours, the temperature must stay rather cool, then remove from the mould.





Remove the gelatine from the mould 1/2



Remove the gelatine from the mould 2/2

4) Knapping

12



Production of the blanks



Example of predetermined blank



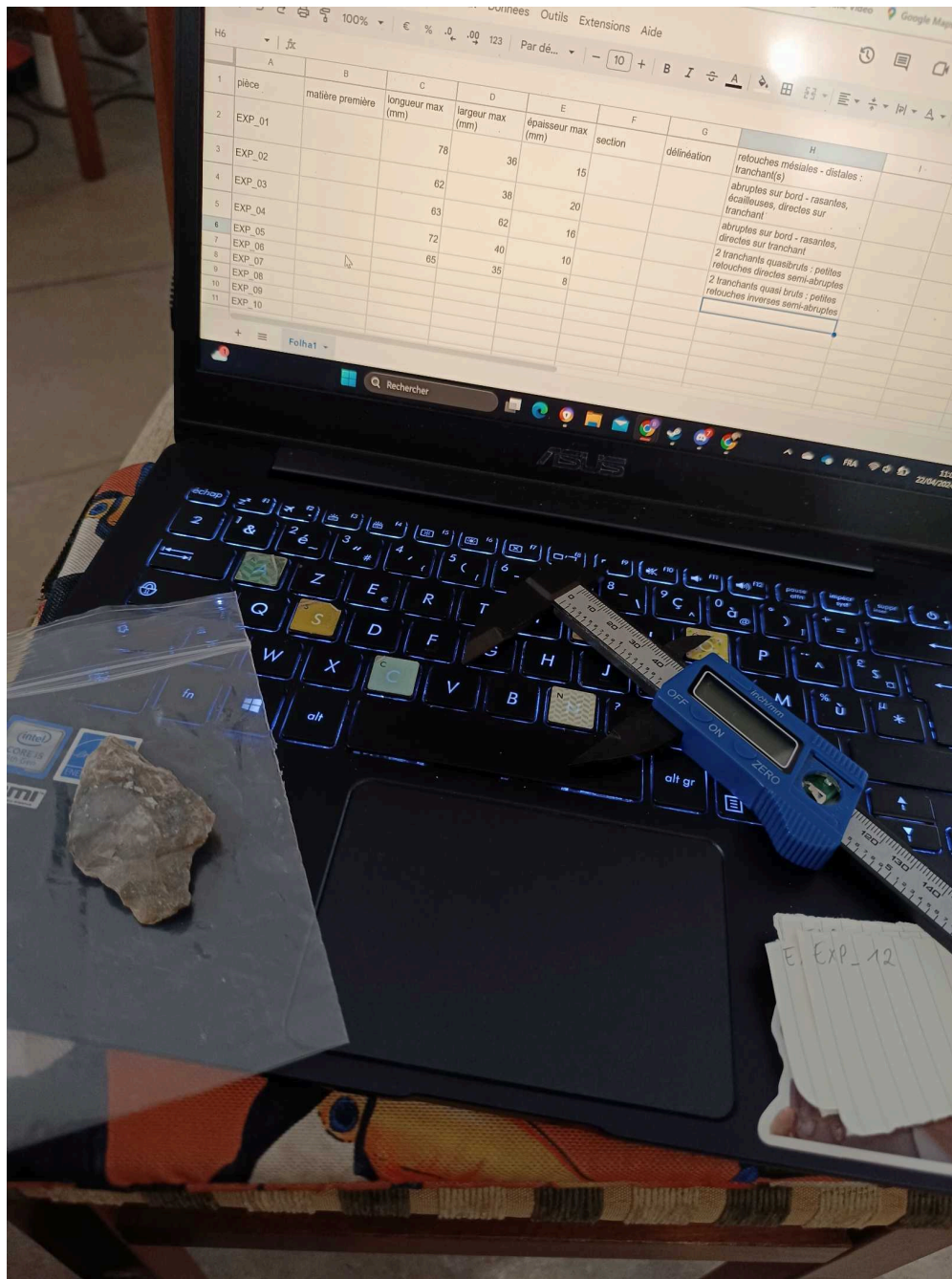
Limestone hammers used for the creation of the tang by bifacial removals

13 Production of (convergent) blanks : 11 in total.



Each of them were assigned to a specific use (2 were eliminated from this picture)

- 14 Creation of a database to register the information :
https://docs.google.com/spreadsheets/d/1HfSV_gF87GJr9aV6UaIQ8rctDjXmvuSQWcvl-Sfw4Mk/edit#gid=0
- 15 Pictures and basic structural drawings of the blanks.



Every blank is registered and described in the database

5) Hafting

16 Lateral hafting (8)

Material required :

- tanged blank

- standardised wooden stick
- animal resin
- vegetal fibre

16.1 Saw the wooden stick in order to split it widely enough to insert the tanged blank as desired.



The wooden stick is sawed

16.2 Insert the tanged blank in the splitted stick by pressing the tang towards the bottom end of the stick and inserting one of the lateral parts of the blank inside the wood.



Tanged blank inserted in the wood laterally

- 16.3 Maintain the position and cover the whole with animal resin (on top and inside of the wood + around the tool). Covering it by spinning above the pot full of animal resin might be easier.
- 16.4 Fix the point by using the vegetal fibre. Secure it by covering as much as you can, but let the active part of the spear show.



The spear is secured by vegetal fibre

- 16.5 Add an extra layer of animal resin on top of the vegetal fibre.



Another layer of animal resin is added

16.6 Let the spear dry.



Spear hafted laterally



The spears are drying

17 **Axial Axhafting (6)**

Material required :

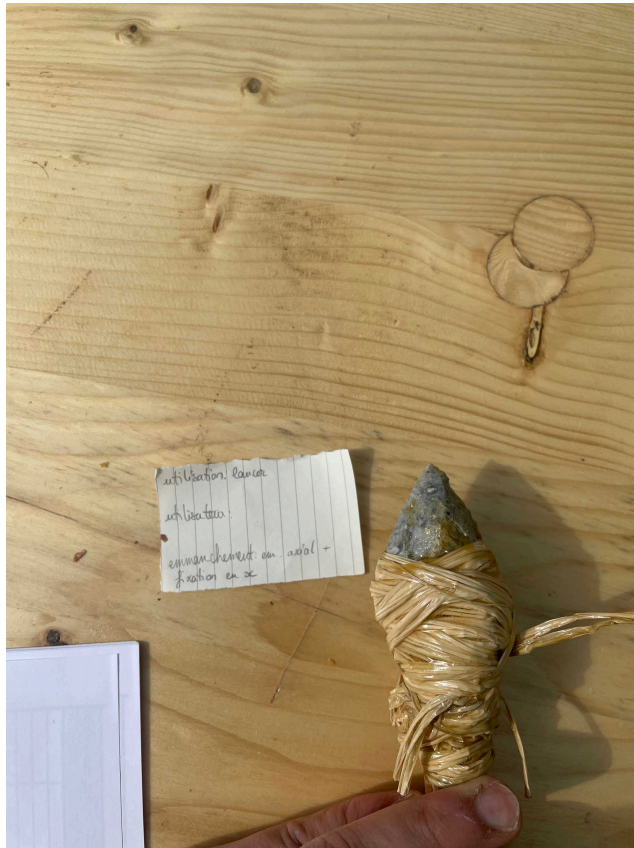
- tanged blank
- standardised wooden stick
- animal resin
- vegetal fibre

- 17.1 Saw the wooden stick in order to split it widely enough to insert the tanged blank as desired.

- 17.2 Reduce the thickness of the stick on the end part and put the tang of the blank on top of the stick. If you use this method, your hafting device must be solid.
- 17.3 Maintain the position and cover the whole with animal resin (on top and inside of the wood + around the tool). Covering it by spinning above the pot full of animal resin might be easier.
- 17.4 Fix the point by using the vegetal fibre. Secure it by covering as much as you can, but let the active part of the spear show.
- 17.5 Let the spear dry.



Spear hafted axially (profile view)



Spear hafted axially (crossed fixation)

18 **Additional step for the hafting of knives.**

- 18.1 Saw your wooden stick to the desired length before hafting the knife.



Drying knife (shorter stick)

6) Spear use

1d

19 Take a picture of everything (for the before / after use comparison).

20 **Cutting** : only one active part used on one raw material (pig limbs).

The cutting was done on pig's trotters. There were two users, doing a skinning action. We cut 7 times all around the leg and every 2 cm, then removed the strips of skin by cutting into the fat. We decided to carry out this action to observe at which level of the paw the marks on the bone are most visible.

Participant 1, who instead moved the knife back and forth, achieved a time of 28.15 minutes for the 7 rounds and 28.28 minutes for removing the strips of skin. Which makes

a complete time of 56.43 minutes.

Participant 2, who cut with a rather sharp gesture, achieved a time of 19 minutes for the 7 rounds and 21.38 minutes to remove the strips of skin. Which makes a total time of 40.38 minutes.

- 21 Make an additionnal database for used tools :
https://docs.google.com/spreadsheets/d/1HfSV_gF87GJr9aV6UaIQ8rctDjXmvuSQWcvl-Sfw4Mk/edit#gid=462676800 (sheet 2)
- 22 **Piercing** : static activity : no run-up. The target is at the experimentator's feet.
Don't hesitate to register individual information (height, weight, hands dimensions...)
Every use was filmed and a picture of the spear was captured after every use.
Every impact was located on the gelatine and marked, especially of a bone was touched.



Picture of the impact on the gelatine after every use



The user was kneeling while piercing the target

23 **Throwing** : Settle with a fix distance for all of the users.

Don't hesitate to register individual information (height, weight, hands dimensions...)

Every use was filmed and a picture of the spear was captured after every use.

Every impact was located on the gelatine and marked, especially of a bone was touched.



The macro-trace of the impact on the tool is circled in red



Fix the same distance for every user for the throwing



Impact on a bone inside c

7) Unhafting

- 24 Cut the vegetal fibre with a knife and carefully extract every blank.



Unhafting

25 Label every blank.



Every blank is labelled

- 26 Extract the potential splinters stuck in the gelatine.

8) Washing

- 27 Lithics : 30 minutes in hot water, then dry with a paper towel.



The tools are washed in hot water to remove the animal resin

28 Bones : extract from gelatine, then put in boiling water.



The bones are boiled



The impact traces are located on the extracted bones



The bones and splinters are extracted from the gelatine

9) Analysis

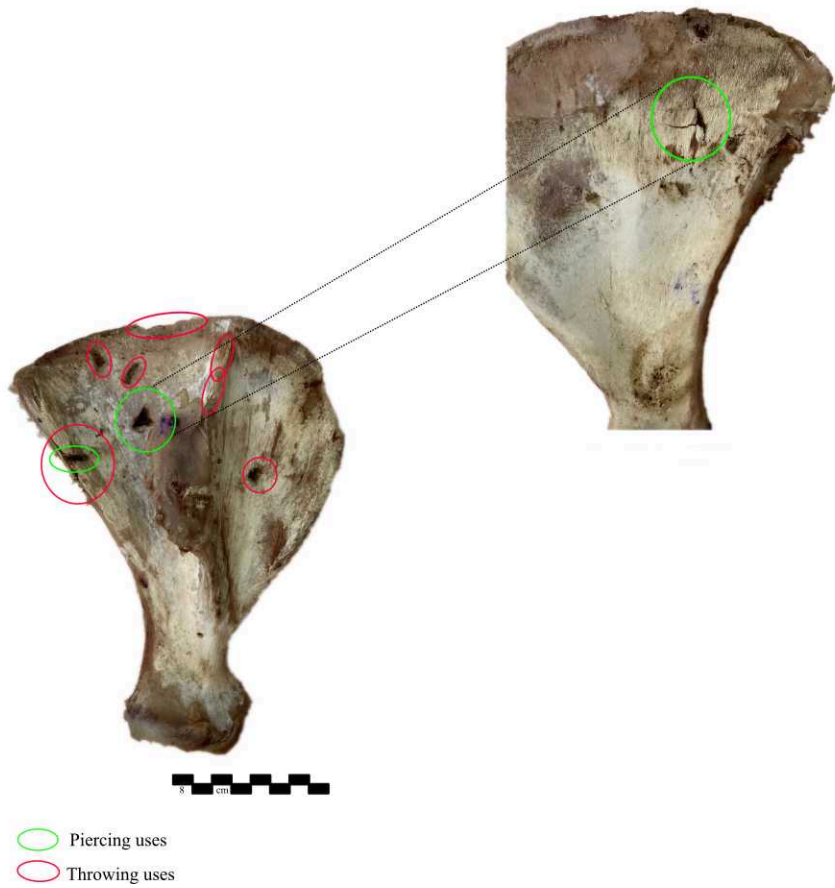
29 Bone analysis.

29.1 Take scaled pictures of the boiled bones.



Scapula A after boiling process

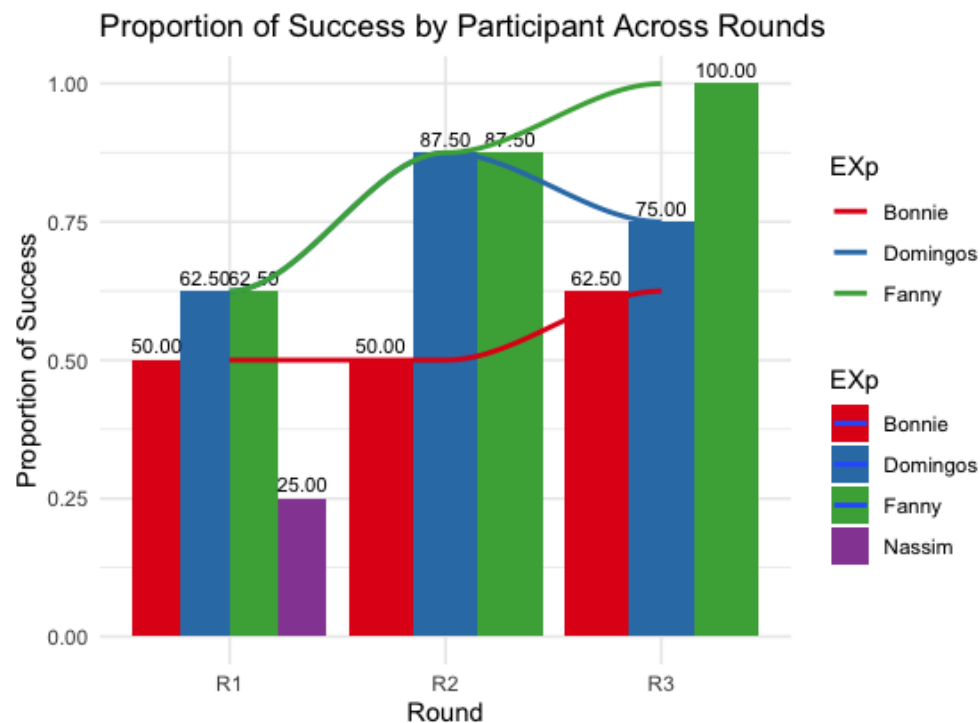
29.2 Identify the traces on the bones and to which use they correspond to.



Scapula A with circled traces

30 Lithics analysis.

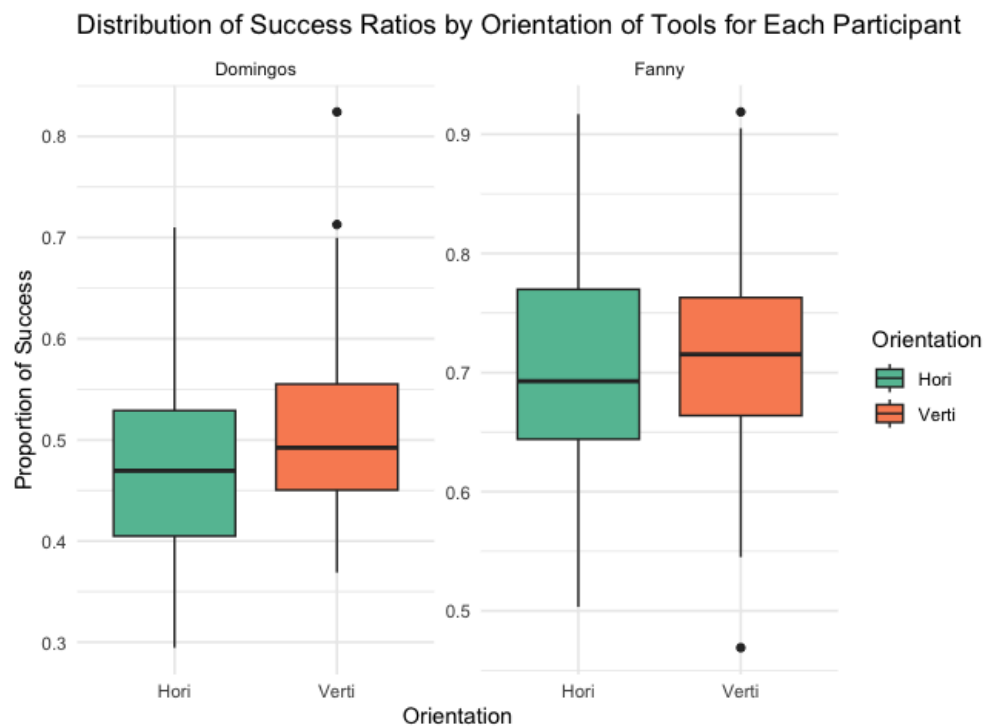
- 30.1 Check the documentation for every use and register how many takes the participants succeeded in, for each use, each hafting system.



Proportion of success by participant across rounds



Proportion of success for every tool orientation per participant ; "Hori" for **axial** fixation and "Verti" for the **lateral** insertion and fixation



Box plot representing the success ratio of Participant 1 (Domingos) and participant 2 (Fanny)

Employ statistical tests by using the R package, to assess whether there were significant differences in success rates between orientations ("Hori" and "Verti"). Two common statistical tests, namely the two-sample **t-test** and the **Wilcoxon rank-sum** test, were used to compare success proportions for each participant individually and when their data were combined.

t_test_fanny	list [10] (S3: htest)	List of length 10
statistic	double [1]	-0.6115694
parameter	double [1]	97.95128
p.value	double [1]	0.5422395
conf.int	double [2]	-0.0475 0.0251
estimate	double [2]	0.703 0.715
null.value	double [1]	0
stderr	double [1]	0.01831431
alternative	character [1]	'two.sided'
method	character [1]	'Welch Two Sample t-test'
data.name	character [1]	'fanny_hori\$Proportion_Success and fanny_verti\$Proportion_Success'

T-test for participant 1

• t_test_domingos	list [10] (S3: htest)	List of length 10
▶ statistic	double [1]	-1.523568
▶ parameter	double [1]	97.63995
p.value	double [1]	0.130849
conf.int	double [2]	-0.06740 0.00886
▶ estimate	double [2]	0.475 0.504
▶ null.value	double [1]	0
stderr	double [1]	0.01921196
alternative	character [1]	'two.sided'
method	character [1]	'Welch Two Sample t-test'
data.name	character [1]	'domingos_hori\$Proportion_Success and dominigos_verti\$Proportion_Success'

T-test for participant 2

• t_test_combined	list [10] (S3: htest)	List of length 10
▶ statistic	double [1]	-0.9888673
▶ parameter	double [1]	197.1524
p.value	double [1]	0.3239401
conf.int	double [2]	-0.0606 0.0201
▶ estimate	double [2]	0.589 0.609
▶ null.value	double [1]	0
stderr	double [1]	0.02046341
alternative	character [1]	'two.sided'
method	character [1]	'Welch Two Sample t-test'
data.name	character [1]	'combined_data_hori\$Proportion_Success and combined_data_verti\$Proportion_...

T-test for both participant

• wilcox_test_fanny	list [7] (S3: htest)	List of length 7
▶ statistic	double [1]	1148
parameter	NULL	Pairlist of length 0
p.value	double [1]	0.4841005
▶ null.value	double [1]	0
alternative	character [1]	'two.sided'
method	character [1]	'Wilcoxon rank sum test with continuity correction'
data.name	character [1]	'fanny_hori\$Proportion_Success and fanny_verti\$Proportion_Success'

Wilcoxon test for participant 1

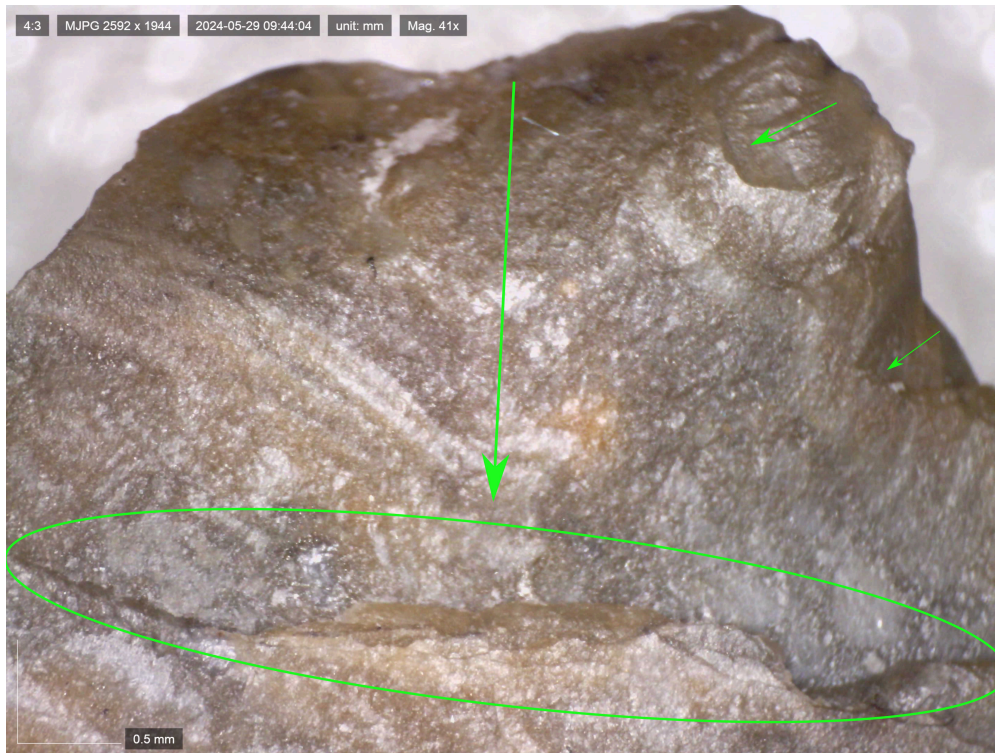
• wilcox_test_domingos	list [7] (S3: htest)	List of length 7
▶ statistic	double [1]	1029
parameter	NULL	Pairlist of length 0
p.value	double [1]	0.128489
▶ null.value	double [1]	0
alternative	character [1]	'two.sided'
method	character [1]	'Wilcoxon rank sum test with continuity correction'
data.name	character [1]	'domingos_hori\$Proportion_Success and dominigos_verti\$Proportion_Succe...

Wilcoxon test for participant 2

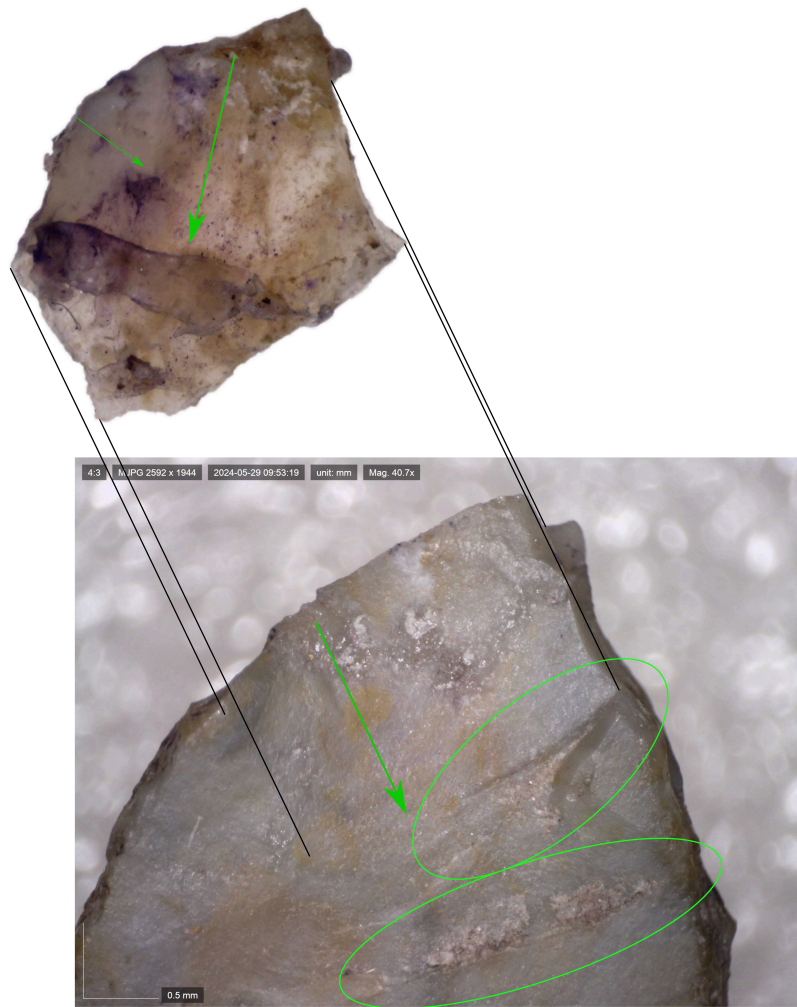

```
wilcox_test_combined  list [7] (S3: htest)      List of length 7
  statistic           double [1]      4620
  parameter           NULL            Pairlist of length 0
  p.value             double [1]      0.3537884
  null.value          double [1]      0
  alternative          character [1]   'two.sided'
  method              character [1]   'Wilcoxon rank sum test with continuity correction'
  data.name           character [1]   'combined_data_hori$Proportion_Success and combined_data_verti$Proportion_...
```

Wilcoxon test for both participant

30.2 Use a dinolite to observe the traces of impact on the different types of hafting / activities. Describe the traces and locate them on every blank.



Impacts on a blank from a lateral hafting device



Impacts on a blank from an axial hafting device (with a matching splinter)

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