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Denticulate Mousterian: A study of Middle Palaeolithic notched tools from Colmont, Limburg, The Netherlands.

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Denticulate Mousterian:

A study of Middle Palaeolithic notched tools from Colmont, Limburg, The Netherlands.



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A study of Middle Palaeolithic notched tools from Colmont, Limburg,
The Netherlands.

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Preface

This master thesis is submitted as occlusion of the Global Archaeology master track at Leiden university for the degree of Master of Arts in Archaeology. The research described in this thesis was conducted under the supervision of Professor Doctor A. Verpoorte between January and June 2022.

In this thesis 174 Palaeolithic artifacts were determined and analysed based on their typology, number of notches and dimensions. Furthermore, a critical assessment of the typologies of Bordes (1961a) and Picin et al. (2011) was conducted. Also, the reduction hypothesis by Holdaway et al. (1996) and Hiscock and Clarkson (2007) was implemented on the assemblage to assess their hypothesis.

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1. Introduction

Denticulated and notched tools are one of the most common artifacts in the Palaeolithic archaeological record. The tools have been recognized as a category within the Mousterian, but they have not been treated as important tools. Therefore, there has been little research about denticulated and notched tools. The variation in forms, their use and how they were made is not well-known (Picin et al., 2011). The questions about these tools are relevant for the so-called Mousterian debate. This debate is about the explanation of the variability within the Mousterian during the Middle Palaeolithic. One of the variants within the Mousterian is the Denticulate Mousterian, which is characterised by a high proportion of notched and denticulated tools. Over the past decades, factors such as culture, function, chronology, environment and tool reduction have been proposed as explanations.

This thesis is a study of the notched and denticulated tools from the Middle Palaeolithic site of Colmont, the Netherlands and aims to contribute to a better understanding of notched and denticulated tools and their role in the variability of the Middle palaeolithic.

1.1 The Mousterian debate

Bordes made a typology for notched and denticulated tools that has been widely adopted by other scholars over the years. The typology is mainly based on Bordes his beliefs that tools are made for a specific function and that the tools are highly stylistic. The variation within these tool types is explained by cultural differences.

The Mousterian was divided in different facies (Mousterian of Acheulean tradition, Typical Mousterian, Denticulate Mousterian and Charentian Mousterian) based on the statistical presence of certain tool types (Figure 1). The different Mousterian phases were at some point believed to be chronological but according to Bordes this was not the case (Bordes, 1961b). In his paper he argues that the Mousterian consisted out of different tribes which had different toolkits. In order to defend his statement, he goes on to debunk some hypothesises that try to explain the differences from the Mousterian. For example, the hypothesis in which it is suggested that different seasons required different tools, or that different environments led to different tool types. The four facies of the Mousterian all have different aspects that distinguishes them from each other.

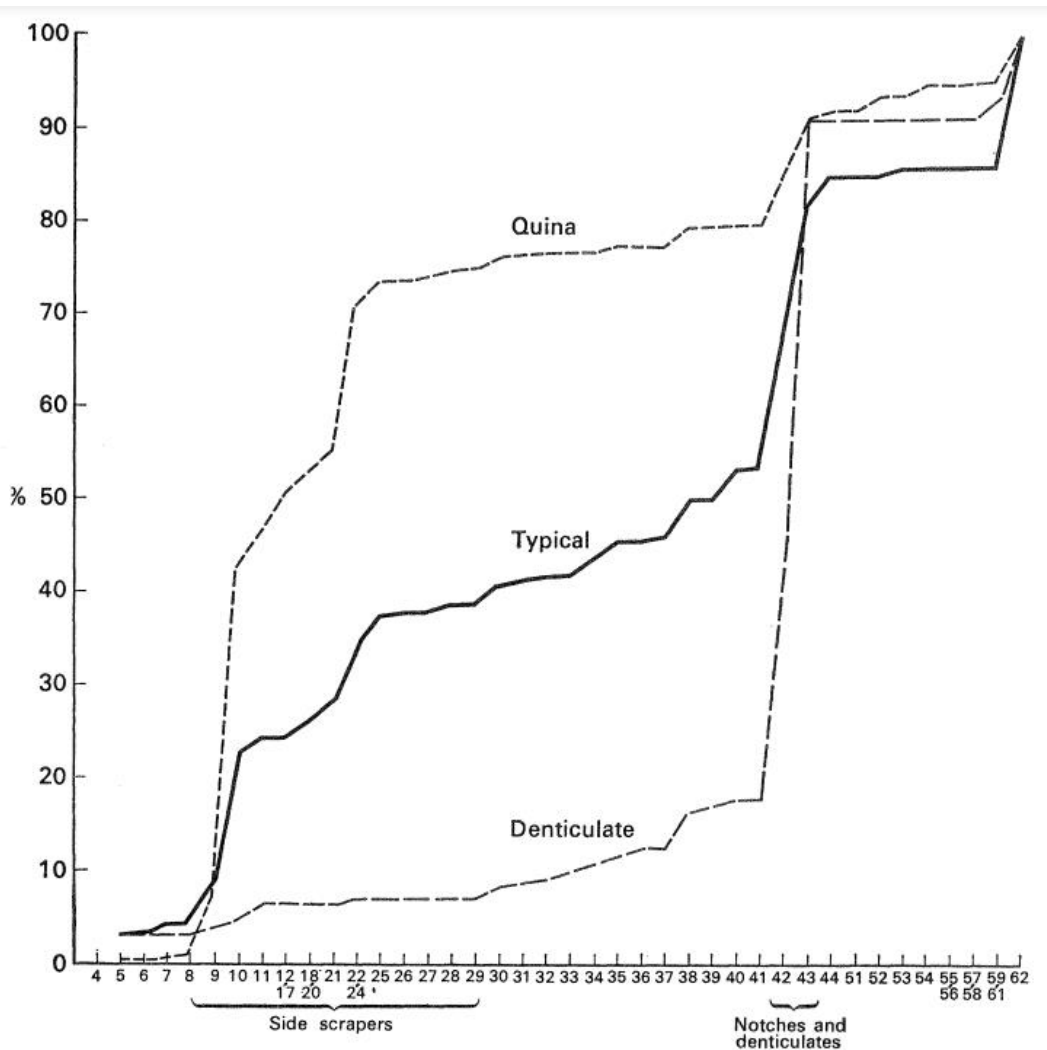


Figure 1, Cumulative graph of the Quina, Typical and Denticulate type.

The Mousterian of Acheulian tradition.

The Mousterian of Acheulian tradition can be divided in two sub-types, sub-type A and sub-type B.

- The Mousterian of Acheulian tradition sub-type A has a variable number of side scrapers, but it is never very high or very low. Denticulate tools often occur in large numbers, in contrast with the Quina scrapers which usually occur in small numbers or are completely absent. Sub-type A also has a variable presence of hand axes which rarely drops below 8% of the assemblage. Baked knives also occur in variable percentages, but almost never occur in higher quantities. The percentage of Levallois flaking is also variable.
- The Mousterian of Acheulian tradition sub-type B has a low percentage of side scrapers and no Quina scrapers as well as a low number of hand axes. Sub-type B has a high percentage of denticulated tools and backed knives and a variable percentage of Levallois flaking. In this type multiple 'Upper Palaeolithic' tools occur, such as end scrapers, burins, borers, truncated flakes and blades. This subtype is chronologically younger than sub-type A (Bordes & De Sonneville-Bordes, 1970, p. 63).

The Typical Mousterian

- Within the typical Mousterian there is a variable percentage of side scrapers, which seems to divide this type into two sub-types. There is a low percentage of transverse scrapers. Quina

scrapers, hand axes and backed knives are either absent or in very low numbers. There is a variable percentage of Levallois flaking (Bordes & De Sonneville-Bordes, 1970, p. 63).

The Denticulate Mousterian

- Within the Denticulate Mousterian there are very few side scrapers and no Quina scrapers. There is a high to very high percentage of denticulated and notched tools. There are no (true) hand axes or backed knives. There is a variable percentage of Levallois flaking (Bordes & De Sonneville-Bordes, 1970, p. 63).

The Charentian Mousterian

The Charentian Mousterian can be divided into two subtypes, the Quina-type Mousterian and the Ferrassie Mousterian.

- The Quina-type Mousterian is characterised by a high percentage of side-scrapers which occasionally drops to circa 50%. There is a high percentage of transverse scrapers and Quina-type scrapers. Hand axes and backed knives are either absent or in low numbers and are of special types when found. There is a very low percentage of Levallois flaking (Bordes & De Sonneville-Bordes, 1970, p. 62).
- The Ferrassie Mousterian is very similar to the Quina-Type Mousterian, with the only difference being a high percentage of Levallois flaking (Binford & Binford, 1966, p. 239).

Binford largely agreed with the typology produced by Bordes and addresses it as one of the most monumental understandings of the variance and different assemblages within the Mousterian. According to Binford and Binford (1966) there is only one problem with the explanation of the variance within the Mousterian, which is that Bordes believes that the variance is caused by culture. Different groups made slightly different tools, this causes the differences between the different Mousterian assemblages. According to Binford and Binford, the variability is caused by function. To assess this hypothesis Binford and Binford selected three sites (Houpeville in northern France, the shelter of Jabrud in Syria and Mugharet es-Shubbabiq in Israel). The three sites that were chosen were either determined by Bordes or under supervision of Bordes, ensuring that, for example, a backed knife at all three sites is the same type of artifact without too much differentiation (Binford & Binford, 1966, p. 243). Binford and Binford made a division in characteristics expected for tools that were used for, for example, butchering or hide working. Based on these characteristics, Binford and Binford tested if different artifacts grouped together, due to their form and associated function. This led to a division of five factors (Binford & Binford, 1966, p. 259):

Factor 1: maintenance tasks such as tool manufacturing

Factor 2: extractive tasks such as killing and butchering

Factor 3: maintenance tasks such as cutting and incising

Factor 4: extractive tasks such as shredding and cutting

Factor 5: extractive tasks such as killing and butchering

Some of these factors have similarities which causes them to group together when plotted in a Cartesian graph, meaning that the tools were used for the same types of activities. This led to a division in camp sites: the base camp, where mostly maintenance tasks were done, kill sites where animals were hunted and butchered, and extraction sites, where plants were collected (Binford & Binford, 1966, p. 267). Based on the method used by Binford and Binford, they determined that one

of the investigated sites consisted out of extractive factors, making the site a work camp, mainly used as kill site. Another site was interpreted as a base camp since it mostly consisted out of the maintenance types. The third site has not been interpreted in their paper. However, this still made Binford and Binford conclude that their hypothesis about variation being caused by function is plausible and therefore suggest that additional research using their method should be conducted (Binford & Binford, 1966, p. 291).

Another explanation for the variability within the Mousterian tool types was brought forward by Mellars (1970). Mellars argues that the variability can be explained based by chronology, meaning that each phase, such as the denticulate Mousterian or the typical Mousterian follow each other. In his paper, Mellars uses the site Combe-Grenal in France to prove his hypothesis about a chronological typology during the Mousterian. In this cave, stratigraphic layers are preserved well which makes dating more reliable. Mellars also points out that he only uses the Mousterian of Acheulian tradition phase and the Quina-type Mousterian phase, since these two phases are most represented of the five Mousterian phases and they have the most distinctive form typologically speaking (Mellars, 1970, p. 141). Mellars (1970) states that at, at least twelve sites the Mousterian of Acheulian tradition is stratigraphically placed above the Quina-type Mousterian phase. Meaning that the latter predates the former. When other researchers reported that they found signs that contradicted Mellars his statement, he discarded these statements by pointing out the flaws such as small-scale excavations and the lack of an elaborate description of the recovered material (Mellars, 1970, p. 142).

Rolland and Dibble did not agree with the fact that the variability within Mousterian tools was explained as stylistic and functional (Rolland & Dibble, 1990, p. 480). In their paper the authors argue that part of the variability of Mousterian tools is due to the availability and quality of raw material. Sites where there is an abundant amount of good quality flint, contain lots of unused flakes, large quantities of waste materials and cores. At sites where flint is less abundant, the assemblage shows highly exhausted cores and carefully reduced flakes (Rolland & Dibble, 1990, p. 484). The quality of the flint can also have influence on the outcome of the tools since different knapping methods are applied that best suit the quality of the flint. The size of the raw material also has an influence on the outcome of the tools. Sites with larger nodules of flint tend to make larger tools such as hand axes and leave more unused blanks. Sites with only smaller nodules available tend to make smaller tools and more notched or denticulated tools, the tools at these sites are also more reduced and worn out than the tools of sites with larger raw material available (Rolland & Dibble, 1990, p. 484).

Furthermore, the environment plays an important role in the manufacturing of different tool types according to Rolland and Dibble (1990). The authors provide an example about the site Arcy-sur-Cure. During the Early Würm cold stadial, there was an open landscape, which made it possible to travel circa 30 kilometres to a location where there was access to raw material and the flint pebbles in the alluvium were more easily accessible. During this period, the site showed signs of the Typical Mousterian with a large number of scrapers. During the following interpleniglacial it became more difficult to access the same flint sources due to the spread of arboreous steppe which concealed the flint sources and therefore the site shifts to a Denticulate Mousterian typology (Rolland & Dibble, 1990, p. 487). Paleoenvironmental evidence showed that the less reduced assemblages such as the Denticulate and typical Mousterian were mostly used during milder climates. When the climate became harsher, more reduced assemblages arose (Rolland & Dibble, 1990, p. 489). Rolland and Dibble conclude that when good quality flint is available and of a large size, many cores and bifaces are produced. If there are any retouched tools, they are slightly modified single edge scrapers and notched tools. When a site is of a larger distance to good quality flint, the local flint is used. These sites are usually characterized by more intensively retouched tools. The imported material is used for

a variety of scrapers and the local material is used for denticulated and notched tools. However, this division is not solely based on the distance from good quality flint, it is also based on the mobility of the group which is affected by the environment and the climate (Rolland & Dibble, 1990, p. 492).

Dibble discovered that scrapers from Bisitun in Iran showed signs of reduction leading to different tool types. At the site, different types of scrapers according to Bordes his typology were present. These scrapers could have one retouched edge, two retouched edges or convergent edges. Dibble argued that these types were the result of reduction, starting off with a single edged scraper which had to be resharpened after a while, leading to a second retouched edge. When both these edges were blunted, they were resharpened until the edges started to converge. Once a minimum width was reached the tool could no longer be resharpened and was discarded (Dibble, 1987, p. 110). To test if this happened with other tools at other sites, the sites La Quina and Combe Grenal in France were studied. It became clear that at the French sites another form of reduction was visible, the tools were not only reduced by retouching other edges of the tools, but also by continuing to retouch and resharpening on one edge. By continuing to retouch one edge of the tool, at one point the working edge crosses the axis of flaking which leads to a transverse scraper. These tools also show a heavier form of retouch than other single edged tools, indicated that they were retouched over a longer period of time before the tool was discarded. The same kind of heavy retouch was present on the converged scrapers (Dibble, 1987, p. 110-111). Based on this Dibble argued that a reduction hypothesis was applicable on the tools. The flake area to platform ratio would indicate how much a tool was reduced before being discarded and how big the flake was before reduction since the flake area was affected by reduction but the platform was not. This showed that larger flakes were more heavily reduced than smaller flakes (Dibble, 1987, p. 114). Not all the tools are heavily reduced before being discarded, therefore the length and width of the tools was examined. This indicated that flakes keep getting reduced until they reach a minimum width at which point the flake can not be reduced anymore and is discarded (Dibble, 1987, p. 115). Therefore, Dibble argues that some of the different types from Bordes his typology represents different stages of reduction and not predetermined tool types.

Other researchers doubted the existence of the Denticulate Mousterian. They believed that the denticulated tools consisted out of pseudo-tools or trampled flint (Thiebaut, 2010, p. 345). In order to test this, Thiebaut conducted research about the difference between intentional notches and accidental/natural notches. She discovered that the angle and dimension of both types differ strongly enough to be able to determine if an artifact contains notches that were man made Thiebaut, 2010, p. 353).

1.2 Explaining the variability of notched tools

An attempt to use the reduction model to explain the variability in the proportions of notched tool types within the denticulate Mousterian was by Holdaway et al. (1996) by using the assemblages of three French sites; Pech de l'Azé I, La Quina and Combe-Capelle bas. Within their research, the artifacts with simple notches were excluded, as were artifacts with retouched sides where one side was not notched, but for example a scraper edge. The main goal of the research was to determine if the number of notches correlated with the length of the blank and if notched tools were intentionally made on a lesser quality flint. Holdaway et al. (1996) found a significant difference between the length of notched, denticulated and end-notched tools at all three sites. It is important to note that this difference was calculated with complete flakes, meaning that the striking platform and the distal end was still present (Holdaway et al., 1996, p. 382). When discarding Bordes his typology and classifying the tools by number of notches a clear trend in the increase of the mean length becomes visible (Table 1) (Holdaway et al., 1996, p. 383). Based on this trend Holdaway et al. hypothesise that this means that blanks were selected to place a notch and when needed, the tools were resharpened by placing a new notch. A longer blank can therefore be reused more often since there is more room to place new notches, and a smaller blank is discarded sooner since there is no room to place a new notch. This would also explain the large deviation in the length of the tools, because the tools were not made according to a stylistic model even though they have the same patterning (Holdaway et al., 1996, p. 384). According to this model, denticulated tools would therefore be a result of reuse and resharpening and not a predetermined end result, as was previously suggested by Dibble (1988). Furthermore Holdaway et al. concluded that at sites where raw material is easily accessed, the notched tools are discarded sooner and at sites where there is no abundant availability of raw material, the tools are resharpened more often by placing additional notches. This could explain why Combe-Capelle bas has such a high number of single notched tools, since the site is located on top of a flint source (Holdaway et al., 1996, p. 384-385).

	La Quina 1		La Quina 2		Combe-Capelle bas		Pech de l'Azé I	
	<i>F</i> =2.1 <i>df</i> =4,105 <i>p</i> =.046		<i>F</i> =4.7 <i>df</i> =3,115 <i>p</i> =.002		<i>F</i> =3.2 <i>df</i> =4,268 <i>p</i> =.007		<i>F</i> =2.4 <i>df</i> =7,307 <i>p</i> =.011	
	n	L (S.D.)	n	L (S.D.)	n	L (S.D.)	n	L (S.D.)
1 notch	54	35.1 (8.3)	40	43.6 (8.9)	178	54.4 (18.3)	81	40.1 (9.9)
2 notches	35	33.4 (5.7)	47	47.2 (8.1)	49	59.1 (21.7)	75	43.5 (10.0)
3 notches	16	39.4 (9.0)	26	51.2 (15.2)	31	65.7 (27.8)	83	44.7 (8.5)
4 notches	4	— (—)	6	56.9 (9.4)	9	66.1 (28.1)	44	45.2 (10.9)
5 notches	1	— (—)	—	— (—)	6	69.9 (21.8)	18	45.0 (10.5)
6 notches	—	— (—)	—	— (—)	—	— (—)	10	46.9 (10.0)
7 notches	—	— (—)	—	— (—)	—	— (—)	3	— (—)
8 notches	—	— (—)	—	— (—)	—	— (—)	1	— (—)

L = mean length

Table 1, Mean lengths in mm of the artifacts per site and per notch group.

Based on the proposed model of Holdaway et al. (1996), Hiscock and Clarkson (2007) hypothesize that the tool type is influenced by the shape of the flake. Meaning that a larger flake could end up as a denticulate because more notches can be placed on it. Furthermore, the authors concluded that the traditional typology of Bordes is an arbitrary division in a large continuum of size and notch placement (Hiscock & Clarkson, 2007, p. 176). The authors state that previous studies always focussed on the evaluation of whether the types by Bordes were specific tools for different functions, or the result of variation in the resharpening of the tools. Therefore, the authors argue that it is necessary to explore the continuum of size and notches related to reduction and the manufacturing process in an economic and social context (Hiscock & Clarkson, 2007, p. 177). To investigate aspects of this issue, Hiscock and Clarkson studied the notched assemblage of Combe Grenal, a site in the Dordogne in France, which was excavated and analysed by Bordes in the 1970's. An important

difference in the method of Holdaway et al. (1996) (and other important analyses) and Hiscock and Clarkson (2007) is that in most studies only the length of the flakes is assessed and tools with simple notches are excluded. Hiscock and Clarkson argue that using only one variable is likely to provide a limited understanding of the reduction processes. To avoid this bias, Hiscock and Clarkson used an analysis of a larger number of traits, such as the number of notches, the notch diameter, notch depth, notch type, weight of the blank, length, width, thickness, the location of the notch, the average Kuhn reduction index and the invasiveness index. Broken flakes were excluded since those influence the average length and possibly do not contain their maximum number of notches anymore (Hiscock & Clarkson, 2007, p. 178). The results of Hiscock and Clarkson their analysis was in accordance with that of Holdaway et al. (1996). The length of the blanks increased with the number of notches. Also, the number of zones with notches increased, indicating notches were added along the edges of the blank during the reduction process (Hiscock & Clarkson, 2007, p. 184). It also became clear that the size of the blanks was influenced by the placement of the notches. A tool with notches on the distal end would influence the length of the blank and notches on the lateral sides would influence the width of the blank (Hiscock & Clarkson, 2007, p. 185). In this study, artifacts with more notches were longer, and half of the total number of notches were located distally or on the left distal side of the blank.

Some of the variation among the notched and denticulated tools could be due to tool reduction over time (Holdaway et al., 1996; Hiscock & Clarkson, 2007). Despite their large variability, the tools were always interpreted as a homogenous category. Denticulated and notched tools have mostly only been classified based on the locations of notches and the assumed function of the tools. The typology of Bordes (1961a), most used to study Middle Palaeolithic assemblages, only identifies two types: notched and denticulated tools. It does not specify them any further whereas there is variation in the way notches are produced, where they are located, and on which type of blank they are made. Picin et al. (2011) suggests that this way of classifying the tools led to a lack of recognizing possible variability. Also, by determining artifacts as a notched tool or a denticulated tool based on the contiguously of the notches there is a lot of room left for interpretation. This causes problems in the uniformity of the determination and makes it difficult to get reliable results on which to base a hypothesis.

Even though denticulated and notched tools have been recognized as a category within the Mousterian typology, their importance as tools is not recognized since there is very little research about their manufacturing. The denticulated and notches tools vary widely in blank size and the number and placement of notches (Picin et al., 2011, p. 711). In order to explore the variability within this tool group, Picin et al. (2011) analysed the flint assemblage from the sites Abric Romaní, in Spain and Grotta Maggiore di San Bernardino, in Italy. Another aim of their research was to determine if different regions followed the same patterns during the production of denticulated and notched tools, or if the production of the tools differed per region (Picin et al., 2011, p. 712). Where other researchers left out tools with a simple notch, Picin et al. (2011) incorporated the tools in their analysis. For both assemblages the length of the notch, the distribution of the concavities on the blank edge, the length of the blank, Kuhn's geometric index, the length of the notched outline and the angle of retouch were measured. In Abric Romaní 311 notched artifacts were recognized, 55% were denticulated tools and 32% were notched tools. In Grotta Maggiore di San Bernardino 169 notched artifacts were recognized out of which 45% were denticulated tools and 32% notched tools, making the denticulated tools at both sites the largest group, followed by the notched tools. Picin et al. (2011) discovered that in Abric Romaní, the notches of denticulated tools were mostly placed on the mesial-distal left side of the blank. In Grotta Maggiore di San Bernardino the notches of denticulated tools were mostly placed on the proximal-mesial right side of the blank. Simple notches and complex notches were at both sites mostly placed on the right mesial or proximal side of the

blank. Another aspect that became clear during the analysis was that the denticulated tools were slightly bigger than notches tools, which was previously suggested by Holdaway et al. (1996) and Hiscock and Clarkson (2007) (Picin et al., 2011, p. 714). However, Picin et al. (2011) believe that this slight difference in size is no proof for the selection of larger blanks for the production of multiple notched tools or denticulated tools, there should have been more universal shapes to prove that there was a predetermined end goal while knapping. Therefore, it seems more likely that the tools are the result of several uses and resharpening phases before the tool was discarded (Picin et al., 2011, p. 716). Based on their results, the authors propose a new typology based on the spatial distribution of notches on the blank. The authors discovered eleven tool types, three notched tools and eight denticulated tools. This is however based on one his interpretation of what a denticulated tool and a notched tool is since Picin et al. (2011) determined tools with two separate notches on the same side of the blank as a denticulate, but according to the Bordesian typology, a denticulated tool has two or more contiguous notches.

There are multiple ways of interpreting tool types and their variability. But the question remains, how much influence does resharpening have on the shape and size of the tools and can the reduction hypothesis really explain this variability? Picin et al. (2011) proposed a new kind of typology that focuses on the placement of notches on the blank and not the entire artifacts in order to map the variability. It is, however, still unclear if this new typology really contributes to the understanding of the variability within the denticulate Mousterian tools and what this new typology contributes.

1.3 Research questions

In this thesis the notched and denticulated tools from Colmont, Limburg, the Netherlands will be studied using the typologies of Bordes (1961a) and Picin et al. (2011). The goal of this is to describe the variation within the different tool types and to determine if one of these typologies is better suited to describe Denticulate Mousterian assemblages.

The research question used to describe this variation is:

1: What types of denticulated and notched tools are present in the assemblage following the typologies of Bordes (1961a) and Picin et al. (2011)? In which proportions do the types occur? What are the main differences between the two typologies?

Another aspect of this thesis is focused on understanding the cause of variability within the Denticulate Mousterian. To reach this goal the reduction hypothesis of Holdaway et al. (1996) and the application of this hypothesis by Hiscock and Clarkson (2007) will be used.

The research question used to assess the cause of variability within the Denticulate Mousterian is:

2: What are the characteristics of the blanks on which the notches and denticulates are made? Is there a correlation between the blank and the tool type? Is there a correlation between the blank and the number of notches?

The assemblage from the site Colmont was chosen because the assemblage is dominated by notched and denticulated tools. The site has been attributed to the Denticulate Mousterian and is one of the few Middle Palaeolithic sites in the Netherlands that contained many notched and denticulated tools.

1.4 Structure of the thesis

In the second chapter of this thesis, the site Colmont will be discussed. In the third chapter the assessment methods are addressed. The fourth chapter, results, will give a description of the assemblage. In this chapter the proportions of notched and denticulated tools and the other variables are addressed. Later in this research the analysis and interpretation will be addressed in chapter 5. In this chapter, for example, the correlation between the length of a flake and the number of notches will be described as well as the differences and similarities between the typologies of Bordes (1961a) and Picin et al. (2011). Following the interpretation, the conclusion of this research will be addressed in chapter 6. In the conclusion the outcomes of this research and the answers on the research questions will be presented. After chapter 6, one can find the abstract of this research and the reference list.

2. The site

The site Colmont-Ponderosa was discovered in 1989. In this year an amateur archaeologist L. Blezer discovered several artifacts on a field near the Ponderosa farm. The field lays on a promontory, called the Vrakelberg, which is situated on the northern edge of the dry valley of Colmont (Figure 2) (Verpoorte et al., 2002, p. 139). The promontory is approximately 175 meters above NAP (Blezer et al., 1997, p. 7). After the first discovery of the site, Blezer visited the site multiple times in the following years, resulting in a collection of more than a thousand middle palaeolithic artifacts. Because there was no distinction in which objects were collected and which were not, the assemblage provided a clear image of the artifacts that were still present at the site. The site consists of artifacts from the Neolithic and Middle Palaeolithic. The palaeolithic artifacts are concentrated in a 40 by 40-meter area on the flank of the promontory (Langbroek & Voormolen, 2002, p. 5). Because the site is located on a promontory and Neolithic artifacts have been found close to the palaeolithic artifacts, there is a possibility that some assumed palaeolithic artifacts turn out to be Neolithic upon further investigation.



Figure 2, Google Earth view of the location of the site, the Vrakelberg, Colmont and the dry valley of Colmont.

In 2001 archaeological research was conducted by the university of Leiden. The aim of the research was to interpret surface artifacts, since these are the most common source of Palaeolithic artifacts in Limburg, the Netherlands. Part of this research were a field survey, geo-archaeological corings, an excavation in three trial trenches and an assessment of the area.

During the field survey, all artifacts were marked in three dimensions in order to provide a map of the distribution of the artifacts. The area was circa 100 by 160 metres, with an angle of inclination of 3.5° on the top of the flank, and 9° on the lower part of the flank. During the field survey two artifact categories were found, ceramics and flint. The ceramics were mostly from the Modern Age.

During the geo-archaeological corings, 68 corings were taken by using an auger. If possible, the corings were taken until the Clay-with-flints or the limestone layer (Langbroek & Voormolen, 2002, p. 6-7). The Clay-with-flints layer forms an unregular but horizontal surface, in contrast with the current relief. The layer contains fragments of flint and limestone. On top of the Clay-with-flints layer, colluvial layers are present. Higher on the plateau, primary loessic depositions are present. Down the slope, the colluvial layers are eroded which causes the Clay-with-flints layer to be the on the surface, along with the lithic artifacts (Figure 3) (Langbroek & Voormolen, 2002, p. 7).

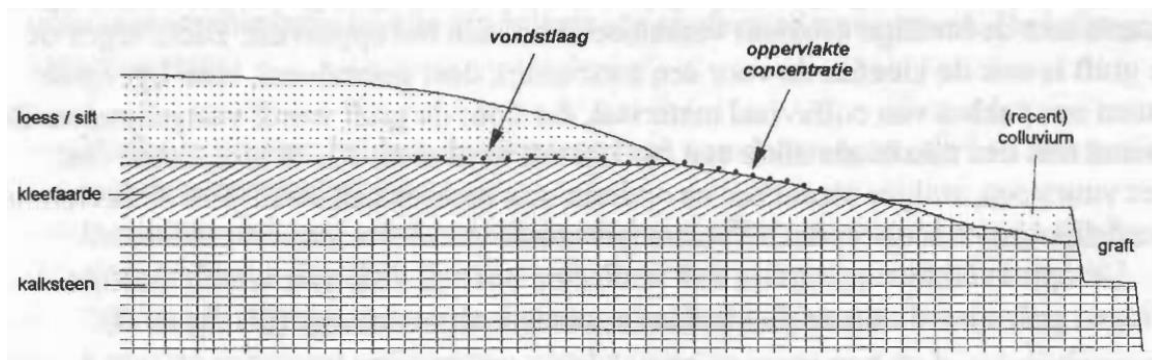


Figure 3, Schematic image of the stratigraphic layers present at Colmont-Ponderosa (Langbroek & Voormolen, 2002). From bottom to top and from left to right: the bottom layer is the limestone layer, on top of that is the Clay-with-flints layer which in turn is covered by a Loessic layer. Then the artifact layer is indicated, followed by the surface concentration caused by the erosion of the Loessic layer. Then the Colluvium layer is indicated followed by the "graft".

Based on the findings from the auger corings, three trial trenches were dug. Trial trench B was located where the arable soil consists out of the Clay-with-flints and the surface finds were concentrated. The trench had an area of 10m² and was dug out to circa 40 centimetres depth.

Trial trench C was located where the loessic depositions had a thickness of at least 1 metre. The trench had an area of 10m² which was dug out till 40 centimetres depth. 5m² of the trench was dug out 1.5 to 2 metres depth.

Trial trench E was located where some part of the loessic layer was still present, but mostly eroded. The Clay-with-flints layer was present slightly under this loessic layer. The area of the trench was 8m² and it was dug out until 1 metre depth.

All trenches were dug out by hand using a shovel, trowel or pickaxe. All artifacts were collected by using square metre sections per depth of 10 centimetres. In total, circa 300 artifacts were recovered from the three trenches, but more than half originate from trench E.

In the proximity of the site a field survey was conducted in an area of circa 11,4 hectares, which was divided into seven parcels. Each parcel was investigated by groups of four to five people in squints with a spacing of 5 metres. All findings were measured using a GPS-recipient. In total the field survey yielded 108 lithic artifacts.

The excavation in the trial trenches made clear that several artifacts were present underneath the arable soil. In trench C and E, the artifacts were covered by the arable soil and therefore protected from erosion and damage by agricultural machines. In trench B the artifacts were on the surface. According to the stratigraphy from trench C and the auger corings, it seems that the site was formed due to a filling of a depression in the limestone layer. The base of this layer consists out of the *Clay-with-flint* layer, alternated by compact flintstone layers. On top of the Clay-with-flints layer, the loessic layer was deposited. Within these layers a clear stratigraphy is visible which was probably caused by slope deposits. The top layer consists out of a colluvium layer of which the first 20-30 cm is considered the arable soil. The artifacts from trench C and E were mostly present in the lowest layers, comparable with the results from the auger analysis, presented in figure 2.

One of the theories explaining the specific concentration of the artifacts is slope erosion. Materials from the top of the slope erode and move downwards. Because of the depression in the limestone layer, the material stays there. Also, due to slope erosion and ploughing, artifacts come to the surface, on the surface they become manageable by the slope erosion again and move further down the slope.

After the fieldwork was finished, the collected artifacts were technologically and typologically analysed. In total 391 artifacts were assessed, originating from the trial trenches or the field survey. 80% of the artifacts had a patina that was quite common for middle palaeolithic artifacts in Limburg. Most of the assemblage consists out of debitage. Only 9% of the assemblage was interpreted as a tool and most of these tools were notched or denticulated. Overall, the flakes are quite thick and broad, without platform preparation. Furthermore, the artifacts are relatively small, ranging from 10 to 50 mm, artifacts smaller than 10 mm were not recovered because the soil was not sieved (Langbroek & Voormolen, 2002, p. 16). Figure 4 provides an overview of the notched and denticulated tools that originated from Colmont.

Based on the cortex of the artifacts it can be concluded that mostly eluvial flintstone was used. Some artifacts contain a cortex formed by fluvial processes, which means that these flint nodules were collected from river deposits. Overall fine-grained flintstone and small nodules were used at this site, which is a sharp contrast with the locally present flintstone. The flintstone that occurs naturally at this site consist of out of coarse-grained nodules with a pipelike shape and many cracks which makes it unsuitable for knapping. The origins of the flintstone artifacts at the site is still unknown (Verpoorte et al., 2002, p. 145).

Based on the location of the artifacts, the patina and the technology used while knapping, most of the artifacts are considered to be middle palaeolithic. A small concentration of neolithic material is present within the site, but the majority dates from the middle palaeolithic. The first phases of modification seem to be missing from the assemblage, it mostly consists out of the final stage of core reduction and tool use. The diversity in flintstone and patina suggest that the site was used multiple times over a long period of time, resulting in a palimpsest.



Figure 4, An overview of the notched and denticulated tools from the assemblage of Colmont.

3. Methods

This chapter explains the methodology that has been used to study the artifacts. Each artefact was described using a set of twenty variables described below. These twenty variables were combined in a database.

3.1 The studied material

The artifacts used in this research are a mix of artifacts from field surveys by amateur archaeologist L. Blezer and some artefacts that were collected during the 2001 fieldwork. In total four artifacts were found in trial trench B. Three artifacts were found in trial trench C and ten artifacts were found in trial trench E. Seven artifacts were found during one of the field surveys. The studied sample consists of 174 artifacts that were provisionally classified as notches or denticulated pieces. Almost all the artifacts are patinated. The patina is mostly whitish, sometimes combined with a distinct gloss. Some of the artifacts have a lot of cortex on their surface, but most of them have little or no cortex. Most of the artifacts are made on a fine-grained flint with a light-grey colour.

3.2 The database

The database consists out of the following columns:

1. Artifact number

Most artifacts did not have an individual number except for about ten tools. In order to identify each specific piece, all the artifacts have been given an individual number. The number is written down on a piece of paper, and then placed in the Ziplock bag along with the artifact.

2. Type

Three general types have been distinguished. These are Notch, Denticulate or Indeterminate. They are based on the following definitions:

- A notch is a flake or blade with a single concavity produced by a single blow, by diverse small contiguous removals or by a single blow that is modified by small removals (Picin et al., 2011, p. 713).
- A denticulate is a flake or blade characterized by two or more notches, isolated or contiguous on the same edge of the blank (Picin et al., 2011, p. 714).

Indeterminate is used when an artifact has no recognizable notches. Other tool classes such as side scraper or biface are mentioned in the remarks.

Three variables are used to describe the dimensions of the artefact. All artifacts have been measured using a digital calliper, the dimensions are in millimetres.

3. Length

The length is measured as the longest axis from the platform to the most distal point of the flake along the flaking axis. In case the platform is not present, the flaking axis was determined by looking at which direction the ripples point. If there is no ventral surface or the flaking axis cannot be determined, the longest length of the artifact was measured.

4. Width

The width was measured as the maximum distance between the two lateral sides of the flake, perpendicularly to the length axis (Figure 5) (Debénath & Dibble, 2015, p. 19).

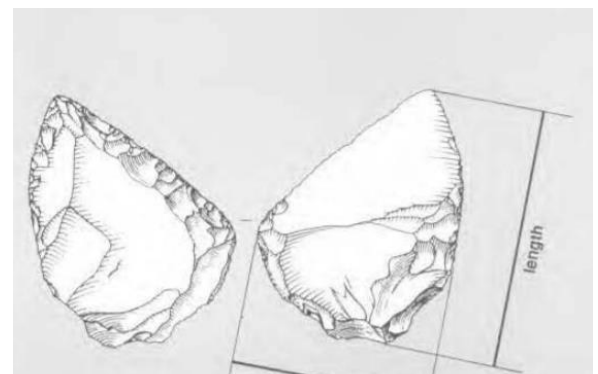


Figure 5, Method of measuring an artifact (Debénath & Dibble, 2015, p. 19).

5. Thickness

The thickness was measured as the maximum distance between the ventral and the dorsal side of the artifact.

6. Cortex

The amount of cortex is measured on all surfaces of the flake excluding the ventral side (De Loecker & Schlanger, 2006, p. 308). Five classes are used to describe the percentage of cortex. In this research, the cortex is considered to be both the chalky exterior of a nodule and natural fissures and neocortex that formed the outside of a raw material block.

0	No cortex
1	0-25% cortex
2	25-50% cortex
3	50-75% cortex
4	75-100% cortex

The percentage of cortex was determined because this is an indication for the stage of reduction. It also indicates which flakes were preferentially selected to make notches and denticulates.

7. Material

In the database, there are three options available: glass-like, fine grained and coarse grained. The classification is rather subjective because of the presence of fine- or coarse-grained inclusions. Some artifacts have coarse-grained inclusions of several centimetres in diameter.

The next set of variables (8-14) describe the number, type and location of notches on the artefact.

8. Number of notches: the total number of notches on the entire artefact.

9. Number of notches on the ventral side

10. Number of notches on the dorsal side

11. Number of notches on the distal side

12. Number of notches on the proximal

13. Number of notches on the lateral left side

14. Number of notches on the lateral right side

Left and right are determined by orienting the artefact with the dorsal side up and the platform to the observer.

The number and placement of the notches is important for the typologies of Bordes (1961a) and Picin et al. (2011)

15. Typology of Picin on the lateral left side

16. Typology of Picin on the lateral right side

17. Typology of Picin on the distal side

Picin et al. (2011) differentiate eleven types based on the number and type of notch on a single edge (Figure 6 and Table 2).

Therefore, the lateral left, right and distal side of an artefact are described separately. Picin et al. (2011) distinguish between simple, complex and mixed notches. A simple notch is a single concavity made by a single blow. A complex notch is a concavity made by several contiguous removals. A mixed notch is a

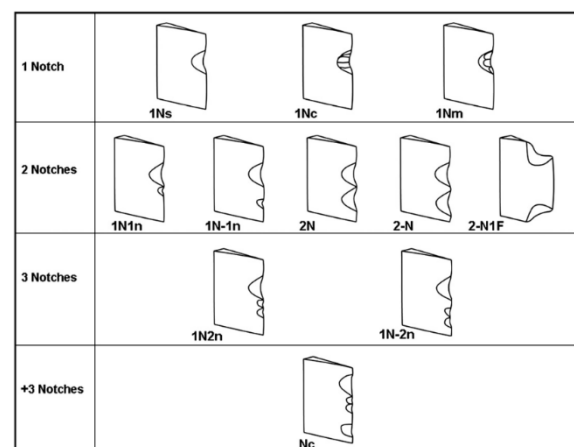


Figure 6, A visual representation of the possible types and placement of notches according to the typology of Picin et al. (2011).

concavity made by a single blow which is then modified by small removals (Picin et al., 2011, p. 713).

18. Bordes (1961a) type

Bordes his typology makes a distinction between six types of notched and denticulated tools (Table 3).

- Type 42, Notches, this type is an artifact with a notch that was made by a single blow or a series of removals that form a concavity (Debénath & Dibble, 2015, p. 104).
- Type 43, Denticulates, are flakes or blades with two or more contiguous notches that form a 'toothed' edge (Debénath & Dibble 2015, p. 106-107).
- Type 44, Alternate retouched becs, are objects with a sharp, pointed extremity caused by the intersection of two notches, one on the interior and one on the exterior (Debénath & Dibble, 2015, p. 108).
- Type 51, Tayac points, are often thick flakes with two denticulated lateral edges which converge towards the end. The retouched edges can be alternate (Debénath & Dibble, 2015, p. 109).
- Type 52, Notched triangles, are triangularly shaped flakes with a single notch on one of the sides (Debénath & Dibble, 2015, p. 106).
- Type 54, End-notched pieces, are flakes and sometimes blades with a notch located on their distal end (Debénath & Dibble, 2015, p. 106).

1Ns	Simple notch
1Nm	Mixed notch
1Nc	Complex notch
1N-1n	1 large notch and 1 small separate notch
2-N	Two separate notches
2-N1f	Two notches separated by a notch
Nc	Denticulate with contiguous notches
1N1n	Denticulate with 1 large notch and 1 small notch
1N2n	Denticulate with 1 large notch and 2 small notches
1N-2n	Denticulate with 1 large notch and 2 separate small notch
2N	Denticulate with 2 notches

Table 2, Different artifact types according to the typology of Picin et al. (2011)

Type 42	Notches
Type 43	Denticulates
Type 44	Alternate retouched becs
Type 51	Tayac points
Type 52	Notched triangles
Type 54	End-notched pieces

Table 3, Different types based on the typology of Bordes (1961a).

19. Remarks

The next column in the database is for remarks on specific characteristics of the artifact. Some examples are evidence of heating or an unusual patination.

20. Photograph or drawing

The last column of the database is for photos of drawings. In case an artifact has characteristics that are beneficial to visually represent, it can either be drawn or photographed.

The database was made in Microsoft Excel in order to collect all the data in a clear way and make the information easily accessible.

4. Results

In this chapter the results of the description of the assemblage will be presented. First, the distribution of notched and denticulated tools will be described, followed by the distribution of Bordes (1961a) and Picin et al. (2011) their typologies. At the end of the chapter an overall description of some artifact types will be given, with a more elaborate explanation of the fabrication and use of these artifacts. The goal of this chapter is to give an insight in the assemblage before going into more detail during the interpretation and analysis in chapter 5.

4.1. Type

During this research 174 artifacts have been examined. Out of these 174 artifacts, 149 were notched tools. These are the biggest group within the assemblage and represents 86% of the artifacts. The denticulates make up for 11% of the assemblage and have a total of twenty artifacts (Table 4). Out of these twenty artifacts four were determined as a Tayac point. Five artifacts did not have any notches and were therefore determined as Indet. Most of these artifacts did have retouch signs but did not meet the requirements to be determined as a notched or a denticulated tool. In total 3% of the assemblage was Indet.

Type	Number	%
Notch	149	86%
Denticulate	20	11%
Indet	5	3%
Total	174	100%

Table 4, The number and percentage of each type of artifact within the assemblage.

4.2 Metrics

In figure 7 a boxplot with the median, average, standard deviation and the range of the measurements is presented. For the boxplot of the length the highest value of the top 25% is 64 mm, and therefore the measurements of 70 and 74 mm are outliers. The same method applies for both the width and thickness. For all three categories there are no outliers beneath the lowest value of the boxplot. For the length, the graph makes clear that 50% of all measurements are between 32 and 45 mm. The median is 38 mm and the average is 39 mm. The standard deviation of the length is 10. The width of the artifacts is comparable with the length, 50% of all artifacts were measured between 31 and 43 mm. The median of the width is 36 mm, the average is 37 mm and the standard deviation is 9. The width has one relatively small outlier of 63 mm. For the thickness, the box with 50% of measurements has a smaller range, namely from 12 to 19 mm. The median and the average are the same with 16 mm and the standard deviation is 5. Thickness has two outliers of 31 and 35 mm.

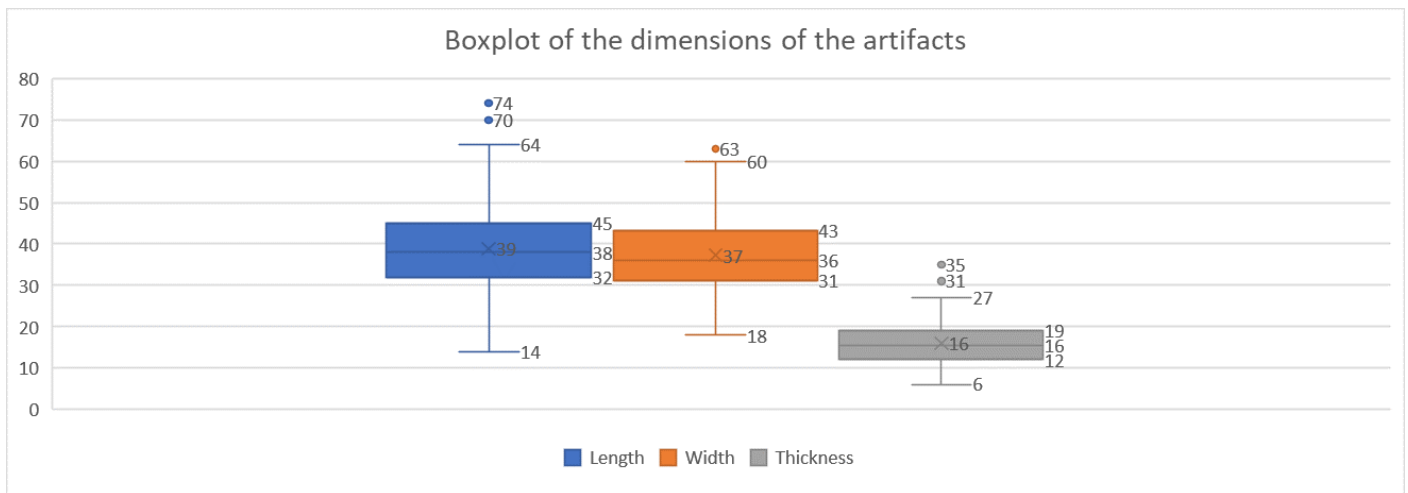


Figure 7, A boxplot of the dimensions of the artifacts with the median, average, outliers and standard deviation.

4.3 Cortex

In Table 4 one can see that 84% of the assemblage had no or no more than 25% cortex. Only 9% of the artifacts had cortex varying between 25% and 50% and just 6% had more than 50% cortex (Table 5).

Cortex	Number of artifacts	Percentage
0%	60	34%
0-25%	87	50%
25-50%	16	9%
50-75%	6	3%
75-100%	5	3%
Total	174	100%

Table 5, The numbers and percentages of artifacts per Cortex percentage.

4.4 Material

In order to determine what kind of flint stone was preferably used, each artifact was classified one of three material types. Since these material types have a gradual range, it is important to keep in mind that some artifacts can be classified differently based on one's interpretation. Some artifacts contain inclusions of more coarse grained flint, which made the determination of these materials sometimes arbitrary. As shown in table 6, 98% of the artifacts are fine grained flint. Just 1% of the artifacts was glass-like and 2% was coarse grained.

Material	Number	%
Glass	1	1%
Fine	170	98%
Coarse	3	2%
Total	174	100%

Table 6, The different flint materials and the number of times they occurred in the assemblage.

4.5 Placement of the notches

In table 7, one can see that 41% of all the artifacts had just a single notch. 33% of the artifacts had two notches and just 16% of the artifacts had three notches. Artifacts with four or more notches are scarcely represented, varying between 5% and 1%. While looking at the total number of notches per side, one can see that 40% of all the notches are located on the lateral right side. The second most used side is the lateral left side, on which 36% of all the notches are located. On the distal side 22% of the notches are placed, and just 1% on the proximal side of the artifacts (Table 8). In one case (A50), the notches were placed diagonally across the artifact, which represent 1% of the notches.

N notches	N artifacts	%
1	70	41%
2	56	33%
3	27	16%
4	9	5%
5	3	2%
6	2	1%
7	2	1%
Total	169	100%

Table 7, The number of artifacts per number of notches and the percentages within the assemblage.

	Number of notches	Percentage
Lateral left	122	36%
lateral right	137	40%
Distal	74	22%
Proximal	3	1%
Diagonal	4	1%
Total	340	100%

Table 8, The number of notches per side and the percentage of notches per side.

4.6. Picin et al. (2011)

A total of 169 artifacts have been assigned a type based on the typology of Picin et al. (2011). Because the typology of Picin et al. does not look at the entire artifact but at just one side at the time, the lateral left, lateral right and the distal side of each artifact have been examined and allocated a type in case there were notches present on that side. In table 9 each of Picin et al. their types are presented with the number of times it was recognized and on which side it was present. The last column presents the percentage of how many times that type was recognized out of 221. The types 1Ns and 1Nm are most present in this assemblage. The type 1Ns was recognized 22 times on the lateral left, 30 times on the lateral right and fourteen times distal. By being present 66 times on an artifact, and 30% out of the total number of 221 types, it is the most present type in this assemblage. Also, when looking at which percentage within the assemblage has this type, 1Ns occurred the most with 39% (table 10). Second is the type 1Nm, which was 22 times present on the lateral left, 33 times on the lateral right and 58 times in total. The type 1Nm represents 26% of the total number of times a type was present and 34% of all artifacts had this type. The type 2N was present ten times on the lateral right and nine times on the lateral left. This type represents 15% of the assemblage and 12% of the total number of times a type was recognized. Type 2-N was present ten times on the lateral right side, but only three times on the left and five times distal. Despite the fact that it seems that the lateral right side was mostly used to place notches, the denticulates (Nc) were mostly placed on the lateral left, six times, and on the distal side, five times. In total 77 different types are present on the lateral left side of the artifacts. 99 types have been placed on the lateral right side of the artifacts and just 45 were present on the distal side.

Type	Picin Left	Picin Right	Picin Distal	Total of the type	% of the total number of types
1Ns	22	30	14	66	30%
1Nm	22	30	6	58	26%
2N	9	10	7	26	12%
1Nc	7	8	6	21	10%
2-N	3	10	5	18	8%
Nc	6	3	5	14	6%
1N-1n	4	7	1	12	5%
1N1n	3			3	1%
2-N1F			1	1	0%
1N2n		1		1	0%
1N-2n	1			1	0%
Total	77	99	45	221	100%

Table 9, The different types of Picins typology for each side of an artifact and how many times they were recognized within the assemblage.

In table 10, for each type the percentage of how many times it was recognized within the assemblage (169 artifacts) and how many times in occurred on one of the sides is presented. While looking at the percentages the types 1Ns and 1Nm are still the most occurring types, especially on the lateral right side of an artifact. The type 2-N was relatively scarce, but it stands out that the type was just 11% of the times present on the lateral left and 56% of the times on the lateral right.

Type	% within the assemblage	% on the left	% on the right	% distal
1Ns	39%	33%	45%	21%
1Nm	34%	38%	52%	10%
2N	15%	35%	38%	27%
1Nc	12%	33%	38%	29%
2-N	11%	17%	56%	28%
Nc	8%	43%	21%	36%
1N-1n	7%	33%	58%	8%
1N1n	2%	100%	0%	0%
2-N1F	1%	0%	0%	100%
1N2n	1%	0%	100%	0%
1N-2n	1%	100%	0%	0%

Table 10, The percentages of the types per side and within the assemblage.

4.7 Bordes

In total 169 artifacts have been assigned a typology based on Bordes' typology (1961a). Out of these 169 artifacts, 148 (88%) were notched tools (Type 42). One artifact was an end-notched piece (Type 54). Four artifacts were determined as Tayac points (Type 51) (Figure 8) and make up for 2% of the assemblage. The denticulated tools (Type 43) are represented by sixteen artifacts and make up for 9% of the assemblage (Table 11).

Bordes	Number of artifacts	Percentage
Type 42	148	88%
Type 43	16	9%
Type 51	4	2%
Type 54	1	1%
Total	169	100%

Table 11, The ratio of the different types of Bordes (1961a) typology present in the assemblage.

In the assemblage four Tayac points have been recognized and two artifacts are possible Tayac points due to their pointy shape. The four tayac points in this assemblage have a very similar shape but vary in their size. By measuring the artifacts from the tip to the base, two artifacts (A28 and A32) are almost similar with a length of 54 mm and 49 mm. The Tayac points have a small amount of cortex on the ventral side. Artifact A22 is the smallest of the four with a length of 40 mm. The largest Tayac point (A24) is 74 mm long and has a slight curve in the tip.



Figure 8, A picture of the four Tayac points. From left to right: Artifact 22, 24, 28 and 32.

4.8 Further observations

On most of the artifacts, clear signs of the percussion method are visible. Most artifacts have a clear bulb with bulb scars. This indicates that the knapper used direct percussion with a stone hammer to make the flakes. Four artifacts contain two or more bulbs which can make it difficult to determine which side is the ventral side of the artifact. The presence of multiple bulbs is a result from removing bigger chunks of flint from a nodule, to use those parts as a core to strike flakes from.

Notched tools with other characteristics

Two artifacts in the assemblage have a rounded edge on which the notches are present. This edge is very similar to Quina scrapers. Lenoir (1986) suggested that pieces with multiple Clactonian notches might be a stage in the production of Quina retouch.

Quina scrapers are well known artifacts that occur in the Middle Palaeolithic assemblages in Europe. Quina scrapers are usually thick and wide flakes, which often still have cortex. The flakes have a so called 'écaillageuse scalariforme' retouch. This retouch provides a broad, sharp working edge, which is very durable (Agam & Zupancich, 2020, p. 2). Due to this durable working edge, the scrapers have a long-life cycle which becomes evident by several stages of retouch. In order to re-sharpen a Quina scraper, the edge was modified by new retouch or notches. Quina scrapers are suitable to use for various activities, such as cutting or scraping (Zupancich et al., 2016, p. 95)

In total four artifacts had a modified edge which resembles a scraper edge. All four possible scrapers are quite similar in size, ranging from 32 mm in length to 42 mm and 23 mm width to 41 mm. Three out of the four possible scrapers still contain some cortex, but no more than 25%.

Bifacial scraper/ Small biface

In this assemblage a relatively small biface (A34) (Figure 9) has been recognized. It is modified on both lateral sides which converge towards a rounded tip. The 'butt' of the biface has not been modified and the centre of gravity is positioned towards the base. The dorsal side of the biface still has around 50% cortex. The lateral left side of the biface has a more angled retouch, which goes almost straight down. The lateral right side of the biface has a more scalar retouch which slowly forms into a sharp edge.

According to Bordes (1961b), this biface could also be a bifacial scraper. Usually, one side of the scraper has scalar retouch and the other side is left unworked or not very neatly retouched. However, in some cases both edges are retouched in the same fashion. This makes them easily mistaken for a biface.



Figure 9, A picture of the distal and ventral side of artifact 34, the small hand axe.

5. Interpretation

In this chapter the results of the determination will be analysed and interpreted. The goal of this chapter is to answer research question 1 and 2. For research question 1: *What types of denticulated and notched tools are present in the assemblage following the typologies of Bordes (1961a) and Picin et al. (2011)? In which proportions do the types occur? What are the main differences between the two typologies?* This chapter will address the differences and similarities of the types that were given to the artifacts by using the typologies of Bordes and Picin et al. in 5.1 and 5.2. The differences in the quantity at which the types of Picin et al. (2011) occur at the site Colmont and the sites Abric Romani and Grotta Maggiore di San Bernardino will be compared in 5.3. This paragraph will also discuss some methods that could add to the information known about Colmont and the assemblage during future research. Next research question 2 will be addressed: *What are the characteristics of the blanks on which the notches and denticulates are made? Is there a correlation between the blank and the tool type? Is there a correlation between the blank and the number of notches?* In order to answer this question paragraphs 5.4 to 5.9 will discuss the correlation between the size of a blank and the number of notches, the size of a blank and the typology of Bordes and the placement of the notches on the blank.

5.1 Are artifacts determined as a denticulate by Bordes (1961a) determined differently by Picin et al. (2011)?

Since Bordes determines a whole artifact without the possibility to acknowledge variation, Picin et al. (2011) made a new typology to regard these variations. Picin et al. (2011) determine each side of an artifact using codes. In order to determine if there are important differences between the typology of Bordes (1996) and Picin et al. (2011), a comparison between both typologies was made. By using the database, it became clear that all the denticulates by Bordes (type 43 and 51), were also determined as a denticulate by Picin et al. (Nc). The main difference in the determination is that according to Picin et al., all artifacts with two notches on the same edge are a denticulated tool. Therefore, the types 1N1n, 1N2n, 1N-2n and 2n are also considered to be a denticulated tool. With Bordes' typology, a denticulate has at least two contiguous notches, which form a toothed edge. Therefore, artifacts with two contiguous notches, which do not form a toothed edge were not determined as a denticulated tool.

5.2 Are there important differences in the typology of Picin and Bordes?

The typology of Bordes regards the whole artifact and says something about the type of artifact, for example the end notched tools, or the tayac points. With the typology of Picin, only the placement of the notches is noted. By only using the typology of Picin et al. (2011), you can see the variation between the placement of notches per side and per artifact, but the typology does not regard the entire artifact. Only when further interpreting the types, you can say something about an artifact, for example that an artifact with type Nc is a denticulate, but type 1N2n is also a denticulate. With the typology of Bordes, the entire artifact is determined into one type, but that does not leave room for variation. Possibly, a better solution than either using one or the other, is to implement both typologies while determining artifacts. Then one can see what kind of tool an artifact is, for example a denticulated tool, and out of what kind of notches the tool contains per side of the artifact. However, the typology of Picin et al. (2011) is not yet complete. The typology was based on the presence of notches on the lateral left and right side of an artifact. In this research the distal and proximal side were added to that. During the determination it became clear that sometimes the notches are placed diagonally across the artifact. Since there is a lot of variation within the

placement of notches, it is nearly impossible to make a type for every possible combination of notches. However, the current list of types needs some more expansion. Furthermore, some notches are placed alternately, for this type of notches there is no typology in Picin et al. (2011) their typology. With Bordes his typology there are the alternate retouched becs, but otherwise there are no options for alternate retouch.

It is hard to conduct an airtight research about notches because some articles consider retouch to be a notch as well and, in this research, notches were deeper concavities that make a hollow form when you look at the edge of the artifact. Also, some researchers distinguish denticulated tools differently. In some cases, a denticulated tool is an artifact with two or more adjunctive notches, and in other cases the adjunctive notches have to make a "toothed" edge. With this much room for personal interpretation it is nearly impossible to design a typology based on the number and placement of notches. In this research the type denticulate was assigned when an artifact had adjunctive notches that form a toothed edge, this edge can be rounded. This likely caused bias when comparing the number of denticulated tools from Picin et al. (2011) their determinations and those from Colmont. As of now Picin et al. (2011) their typology is based on the analysis of only two sites. As has been pointed out in this thesis but also in the literature that has been used, including Picin et al. there is a lot of variability within the denticulate Mousterian. By using only two sites to make a new kind of typology that was intended to better show the variability, the typology does not fit all types of notches on a blank. At Colmont for example, other sets of notches were discovered such as diagonally placed notches. To improve the typology of Picin et al. (2011) it is suggested to analyse more sites from different regions, but also multiple per region to get a better understanding of the variability. Also, the typology of Picin et al. leaves no room for the interpretation of the tools. By combining it with Bordes (1961a) his typology more information becomes available about the tool, such as if it is a Tayac point or a denticulated tool

5.3 Does Colmont differ from other sites that were determined with Picin et al. (2011) their typology?

At Colmont the single notches such as 1Ns 1Nm and 1Nc represent 66% of the assemblage. At the other sites, the single notches are less abundant in percentage with 39% at Abric Romaní and 36% at Grotta Maggiore di san Bernardino. At Colmont there are very few denticulated tools (Nc), only 6%. At Abric Romaní and Grotta Maggiore di san Bernardino the denticulates are almost double that of Colmont with 14% and 11%. At Abric Romaní it seems that other types with multiple notches such as 2N, Nc and 1N1n are also important types with a total of 35%. At Grotta Maggiore di san Bernardino the percentages are spread more or less evenly over the types, except for the complex notches (1Nc). In Abric Romaní the pursued product was the simple notch because this type has a high frequency during successive resharpening phases. However, as the reduction continues, the number of mixed notched increases, possibly due to the reworking of simple notches. At Grotta Maggiore di San Bernardino the pursued artifact is the complex notch. It seems that at Abric Romaní, tools were modified with an abrupt termination after which resharpening was necessary to decrease the angle of the edge before continuing with retouching. At Grotta Maggiore di San Bernardino, denticulated tools were retouched over a longer period of time before resharpening was needed (Picin et al., 2011, p.717). At Colmont the phases of reduction were not researched, but as has been shown by Picin et al. (2011) this can give important insights about the pursued artifact at the site and therefore explain the frequency at which some types occur within the assemblage. It could also help to understand how denticulated tools were manufactured and if they indeed are a result of resharpening or are a pursued artifact.

At Grotta Maggiore di San Bernardino and Abric Romaní different occupational layers were discovered. The types of tools differ slightly in each layer which helps to understand the reduction phases but also the use of the site. Abric Romaní is characterised by multiple short-term occupation phases that have caused a palimpsest at different levels of the site. At Grotta Maggiore di San Bernardino there is a sharper contrast between the occupation levels which indicate persistent and repeated settlements but also some short-term occupation episodes. Picin et al. (2011) do not specify which tool types indicate short-term or long-term occupations, but they do argue that the different types must be associated with the duration of the occupation and not the function of the tool (Picin et al., 2011, p. 718). For the assemblage used in this research there is no record about in which layer the artifacts were discovered. Therefore, it is not possible to determine different occupation phases in the way Picin et al. (2011) did. However, if future research provides the possibility to research tools from different layers at Colmont, it would be very beneficial for the understanding of the site.

Another explanation provided by Picin et al. (2011) for the variation within the assemblages, but also between the sites of Abric Romaní and Grotta Maggiore di San Bernardino is the use of hard or soft percussion. At Grotta Maggiore di San Bernardino the use of bone percussion has been recognized, which results in lighter and narrower removals than stone percussion would have. At Abric Romaní, no signs of bone percussion have been recognized. Picin et al. (2011) argue that denticulated tools are the result of diverse percussion methods which have been used over time. This would imply that denticulated and notched tools are the result of specific knapping methods and not a result of coincidence (Picin et al., 2011, p. 717-718). Researching the percussion method used for the notches on the tools from Colmont could help understand if certain methods were used for specific tool types and if denticulated tools are indeed a result of the combination of different methods over time. By determining if certain methods were used for specific types more information about the production but also the variability of notched and denticulated tools would come available. Possibly a new way of explaining and researching the variability of these tools would lie within the manufacturing of these tools, which has currently not been researched in depth.

Another thing that became evident based on the analysis of the tools from Abric Romaní and Grotta Maggiore di San Bernardino is that some tools are 'mobile' while other tools are made within the camp site. At Abric Romaní denticulated tools were imported into the site from elsewhere and were part of a mobile toolkit which was regularly transported between sites. At Grotta Maggiore di San Bernardino however, the denticulated tools were made from a local flint and are associated with domestic activities conducted at the site. The denticulated tools are therefore interpreted as the least mobile tools from the assemblage (Picin et al., 2011, p. 718). At Colmont there is not much known about the origins of the flint besides that the tools were made from a not local flint material. The flint that is present at the site is of a low quality full of internal cracks and therefore less suited to make tools. Future research of the site at Colmont could focus on the origins of the flint that was used to make the tools in order to determine if there is a similar kind of distinction as the one at Abric Romaní and Grotta Maggiore di San Bernardino.

	Colmont		Abric Romaní		Grotta Maggiore di san Bernardino	
Type	N	%	N	%	N	%
1Ns	66	30%	58	17%	16	9%
1Nm	58	26%	32	9%	24	13%
2N	26	12%	37	11%	13	7%
1Nc	21	10%	43	13%	43	24%
2-N	18	8%	26	8%	13	7%
Nc	14	6%	48	14%	20	11%
1N-1n	12	5%	3	1%	4	2%
1N1n	3	1%	34	10%	16	9%
2-N1F	1	0%	7	2%	13	7%
1N2n	1	0%	41	12%	15	8%
1N-2n	1	0%	13	4%	6	3%
Total	221	100%	342	100%	183	100%

Table 12, An overview of the number of tools and percentages for each Picin type per site.

5.4 Is there a correlation between the length of the blank and the number of notches?

To determine if there is a relation between the length of the flake and the number of notches, the values were placed in a graph. In figure 10 one can see a pyramid like shape, which indicates that most notches are placed on flakes with a length between 20 and 60 mm. Flakes that are smaller or larger than these values rarely have notches. The figure also shows that most flakes contain one or two notches. The pyramid reaches its maximum number of notches around 35 mm and then starts descending. The artifacts with most notches, seven or six, do not fit nicely in the pyramid like shape. Something that is remarkable is that the two artifacts with six notches are around 65 to 75 mm instead of the average between 20 and 60 mm. The artifacts with seven notches are smaller however, and do fit between the range of 20 to 60 mm. The two artifacts with six notches are determined as a denticulate, specifically one tayac point and one denticulate. The two artifacts with seven notches are also determined as a denticulate, specifically one small hand axe and one tayac point. Figure 11 shows that the length drops after two notches, and then drastically increases at more than four notches, the standard deviation of this group is very large, indicating a large variety of lengths. This assemblage only has three artifacts with five notches, two with six notches and two with seven notches.

According to figure 11 one can conclude that the reduction hypothesis of Holdaway et al. (1996) is not applicable on this assemblage. If there was a relation between the length of a flake and the number of notches, the figure would have presented an ascending line since the theory claims that the larger a flake is the more notches it contains. Figure 10 however seems to indicate that there was a preference for flakes with a length between 20 and 60 mm. Also, the large difference between the tools with six notches and seven notches is not explainable based on their typology. One artifact with six notches is determined as a tayac point, as is one of the artifacts with seven notches. The other artifact with six notches is determined as a denticulated tool and the other artifacts with seven notches is determined as a small hand axe. Since all four artifacts are a denticulate, the typology of these artifacts does not explain their difference in size and probably are just outliers. When this data is compared to table 13, it becomes clear that the length of the tools is very comparable with the tools from La Quina 1 (Holdaway et al., 1996, p. 383). However, Holdaway et al. show that the mean length of the tools increases along with the number of notches. Only two sites contained a small deviation, which was Pech de l'Azé I, where tools with five notches are slightly smaller (0.2 mm) than tools with four notches and La Quina 1 where tools with two notches are notably smaller than tools with a single notch. Also, when comparing the results from Combe Grenal (Hiscock & Clarkson, 2007)

(Table 14) with the results from Colmont, it becomes clear that the length of the tools from Colmont do not follow the same trend of an increasing length with an increasing number of notches. The tools from Combe Grenal are not only increasing per notch. The tools with four to six notches are also much larger than the tools with more than four notches from Colmont. Therefore, it seems that the theory of Holdaway et al. is not applicable on this assemblage when using the length of the tools.

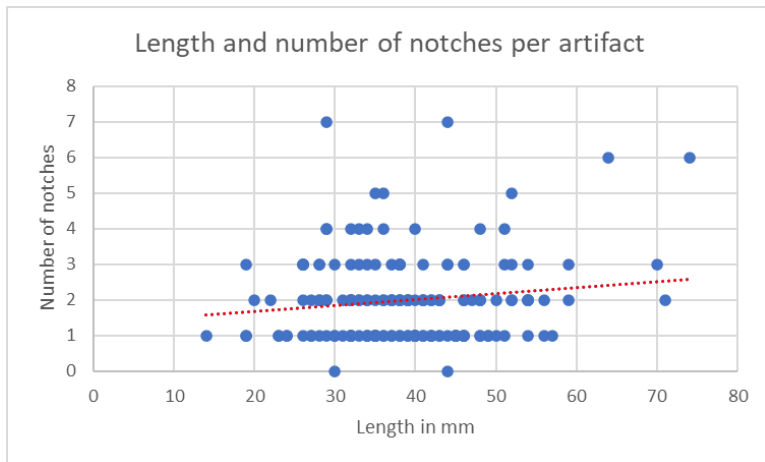


Figure 11, A graph in which all the lengths of the artifacts are compared with the number of notches on that artifact.

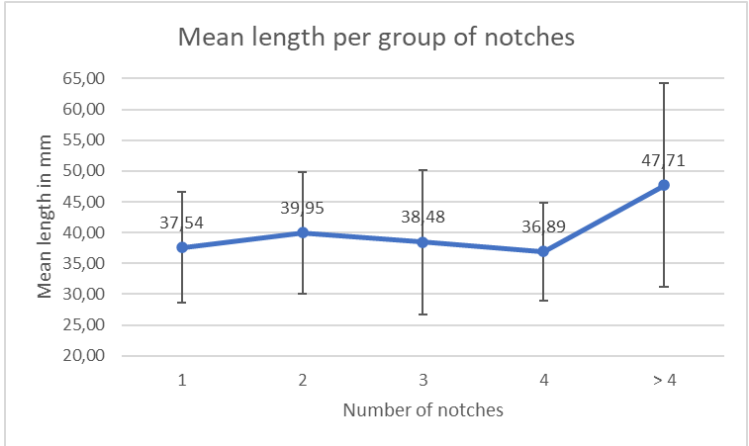


Figure 10, A graph with the mean values of the length per number of notches and the standard deviation per number of notches.

	La Quina 1		La Quina 2		Combe-Capelle bas		Pech de l'Azé I	
	n	L (S.D.)	n	L (S.D.)	n	L (S.D.)	n	L (S.D.)
1 notch	54	35.1 (8.3)	40	43.6 (8.9)	178	54.4 (18.3)	81	40.1 (9.9)
2 notches	35	33.4 (5.7)	47	47.2 (8.1)	49	59.1 (21.7)	75	43.5 (10.0)
3 notches	16	39.4 (9.0)	26	51.2 (15.2)	31	65.7 (27.8)	83	44.7 (8.5)
4 notches	4	— (—)	6	56.9 (9.4)	9	66.1 (28.1)	44	45.2 (10.9)
5 notches	1	— (—)	—	— (—)	6	69.9 (21.8)	18	45.0 (10.5)
6 notches	—	— (—)	—	— (—)	—	— (—)	10	46.9 (10.0)
7 notches	—	— (—)	—	— (—)	—	— (—)	3	— (—)
8 notches	—	— (—)	—	— (—)	—	— (—)	1	— (—)

L = mean length

Table 13, Mean lengths in mm of the tools from La Quina, Combe-Capelle bas and Pech de l'Azé I (Holdaway et al., 1996).

Number of Notches	Weight (g)	Length (mm)	Width (mm)	Thickness (mm)
1 (N = 41)	17.14±9.43	36.69±9.94	33.85±10.33	12.73±4.51
2 (N = 27)	24.15±15.11	42.59±12.95	33.41±9.54	12.75±4.14
3 (N = 12)	24.22±10.35	43.19±15.31	37.00±12.43	11.33±3.25
4-6 (N = 3)	31.75±0.60	57.85±28.73	34.40±24.40	11.04±1.82

Table 14, Mean values in mm of the tools from Combe Grenal (Hiscock & Clarkson, 2007).

5.5 Is there a relation between the width of a flake and the number of notches?

When the relation of the width of the flake and the number of notches is compared, more or less the same image as for the length appears. In figure 12 a pyramid like shape indicates that most notches are placed on artifacts with a width between 20 and 60 mm. The peak of the number of notches is at 35 mm. When the mean value of the width is calculated per group of notches, another kind of image appears. In figure 13, the mean values ascend, indicating that in this case the width of the blank correlates with the number of notches.

Figure 12 does not show an ascending line, which would be expected according to the reduction hypothesis. With this image however, one could theorize that artifacts wider than 60 mm are at the binning of the reduction stage and therefore hold little to no notches. Then the number of notches increases to its maximum around 35 mm. At this point the artifact becomes too small to place more notches without removing the previous ones, therefore the artifact still shrinks but so does the number of notches. According to Hiscock and Clarkson (2007) a blank that has a higher number of notches should be longer because the knapper needs enough space to place all the notches. In figure 13 there is an ascending line which seems to indicate a correlation between the width of the blank and the number of notches. At more than four notches there is a small drop in the mean width, this however is very small and could be explained by the high standard deviation at four notches. In this case it seems that the knappers looked for wider blanks to place multiple notches. It is however important to note that all mean values have a large standard deviation margin, except for tools with more than four notches, and the difference in the mean lengths is very small. The width of the tools from Colmont are very comparable with the length of these tools, but also to the length of the tools from La Quina 1. Also, figure 13 shows an ascending line, which is in accordance with the trend we see in table 12 from Holdaway et al. (1996) their research. The increase in mean width is however very small and the standard deviation very high. When comparing the width of the tools from Combe Grenal it becomes clear that the opposite of what was expected by using the reduction hypothesis is the case for Colmont. At Colmont the width of the tools increases with the number of notches. But at Combe Grenal (Hiscock & Clarkson, 2007) and in the study of Holdaway et al. (1996), the length of the tools increases with the number of notches.

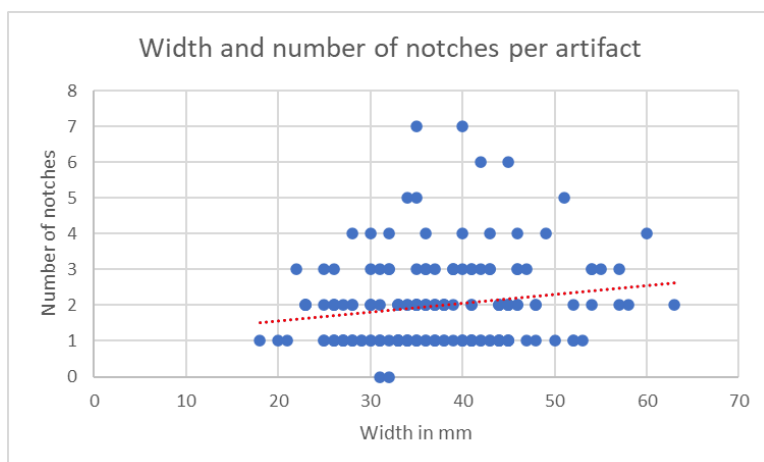


Figure 13, A graph in which all the widths of the artifacts are compared with the number of notches on that artifact.

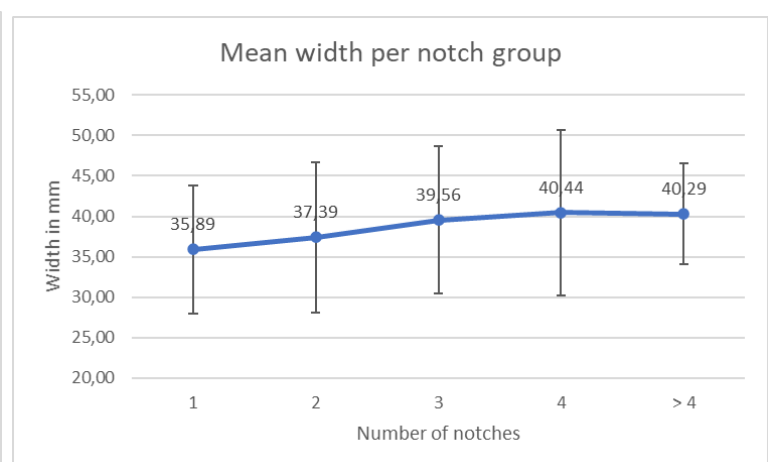


Figure 12, A graph with the mean value of the width per number of notches and the standard deviation per number of notches.

5.6 Is there a relation between the thickness of a flake and the number of notches?

When looking at the relation of the thickness of the flake and the number of notches on that flake, once again, a pyramid like shape appears (figure 14). In this case most artifacts have a thickness of circa 7.5 to 25 mm. The maximum number of notches is around 15 mm. The outliers are this time not connected to a high percentage of notches. The two outliers, which are due to their thickness, contain only one notch each. The artifacts with seven and six notches all fit into the range of the pyramid like shape in this comparison. When looking at the mean thickness (Figure 15) it becomes clear that every group of notches have more or less the same mean value. Only at more than four notches there is a significant increase in the thickness of the flakes.

In both figure 14 and 15 there are no signs of a correlation between the thickness of the flakes and the number of notches. The thickness of the blanks is more or less the same for all notch groups, except for the tools with more than four notches. These are significantly thicker than the other tools. Within the typology there seems to be no explanation for the significant increase in the mean thickness at more than four notches, all artifacts were determined as a denticulate, some further specified as tayac points. This however does not indicate that denticulates are thicker than other artifacts, since there are also denticulates in the other notch groups with a lower mean thickness. The large difference in the mean thickness for tools with more than four notches could indicate that tools with multiple notches are thicker than tools with fewer notches. The tools from Combe Grenal also show a more or less constant thickness. The tools are however thinner than the tools from Colmont and do not have a thicker group of notched tools.

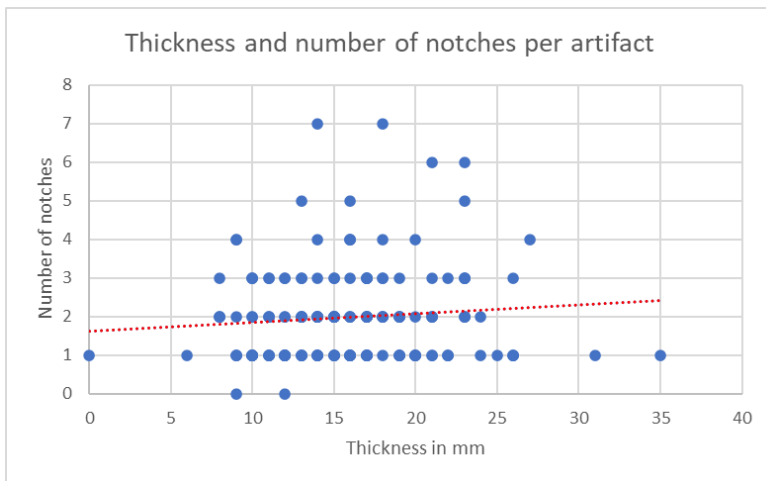


Figure 15, A graph in which all the thicknesses of the artifacts are compared with the number of notches on that artifact.

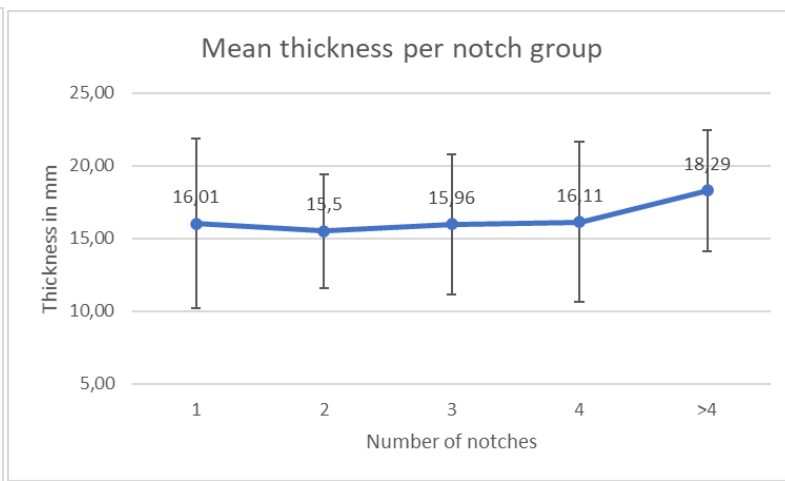


Figure 14, A graph with the mean values of the thickness per number of notches and the standard deviation per number of notches.

5.7 Is there are relation between the different types of the Bordesian typology and the size of the blank?

The previous paragraphs have shown that tools with more notches are wider than tools with fewer notches. The thickness stays constant until a blank has more than four notches and the length has an unpredictable trend. Since denticulated tools tend to have more notches than notched tools, the measurements of the four Bordesian types will be compared. The second longest tool group from Colmont are the notched tools, these are however the narrowest and thinnest tools (Table 15). At La Quina 1 the notches tools are also the longest tools. At La Quina 2 the notched tools are among the smallest, as well as at Combe-Capelle bas and Pech de l'Azé I (Table 16). At Combe Grenal the notched tools are the smallest and among the most narrow and thin tools (Table 17). The denticulated tools from Colmont are among the smaller tools but are the widest and among the thicker tools. At La Quina 2, Combe-Capelle bas and Pech de l'Azé I the denticulated tools are the longest. At Combe Grenal the denticulated tools are the longest, widest and thickest of the four types. In the assemblage of Colmont the Tayac points are the longest and thickest tools. However, the standard deviation of these tools is very high, and there are only four tayac points in this assemblage. The tayac points from La Quina 2 and Pech de l'Azé I are among the longer tools of the assemblages. At Combe Grenal the tayac points are among the longer tools, but they are the thinnest and narrowest of the assemblage. In the assemblage of Colmont, only one end-notched tool was recognized which makes it unreliable to compare this tool with the mean lengths of the other tools. It does however follow the trend of La Quina 1 and 2, Combe-Capelle bas and Pech de l'Azé I of being the shortest tools of the four.

Type	N	Lenght	S.D.	width	S.D.	thickness	S.D.
42, Notched tool	148	38,86	9,72	36,91	8,69	15,77	4,82
43, Denticulated tool	16	37,44	11,03	41,38	8,98	16,89	5,55
51, Tayac point	4	47,25	21,03	40,75	6,99	18,25	3,10
54, End-notched tool	1	30,00	-	28,00	-	10,00	-

Table 15, Mean values in mm and the standard deviation per Bordesian type.

	n	L (S.D.)
La Quina 1		
Notched flakes	43	36.6 (8.0)
Denticulates	55	35.7 (8.1)
Tayac points	—	—
End-notched flakes	12	30.0 (6.8)
La Quina 2		
Notched flakes	39	44.8 (8.4)
Denticulates	76	49.3 (11.5)
Tayac points	1	45.5 (—)
End-notched flakes	3	33.0 (5.8)
Combe-Capelle bas		
Notched flakes	158	55.6 (18.7)
Denticulates	92	61.7 (25.0)
Tayac points	—	—
End-notched flakes	23	50.8 (18.9)
Pech de l'Azé I		
Notched flakes	93	40.5 (9.7)
Denticulates	217	44.8 (10.0)
Tayac points	5	42.8 (6.6)
End-notched flakes	13	39.6 (7.2)

Table 16, Mean length in mm of the tools from La Quina 1 and 2, Combe-Capelle bas and Pech de l'Azé I (Holdaway et al., 1996).

Implement Type	N	Weight (g)	Length (mm)	Width (mm)	Thickness (mm)
42, Notched flake	35	19.29±12.55	36.63±10.59	32.27±9.45	12.10±3.82
43, Denticulate	42	23.19±12.09	43.71±14.32	34.46±10.22	12.84±4.39
51, Tayac point	2	11.50±1.70	39.22±15.91	22.07±1.43	10.37±1.15
54, End-notched flake	4	26.65±10.98	38.64±4.91	41.91±7.68	14.54±6.59

Table 17, Mean length, width and thickness in mm of the tools from Combe Grenal. (Hiscock & Clarkson, 2007).

5.8 Is there a difference between the size of a denticulated and a notched tool?

Earlier in this research we determined that a denticulated tool is an artifact with two or more contiguous notches. In this assemblage there were no denticulated tools with two notches, the lowest number of notches on the denticulated tools is three. This overlaps with the highest number of notches on notched tools, which is also three. Since an artifact is only determined as a denticulated tool when the notches are contiguous, there could be some overlap between the number of notches on both tool types. In this assemblage however, notched tools have one to three notches, and denticulated tools have three to seven notches. The boxplot (figure 16) shows that for the notched tools, 50% of the artifact have either one or two notches, therefore the median is one notch and the average is 1.69 notches. There is one notched tool which contains four notches, and therefore is an outlier. Of the denticulated tools, 50% contain between three to five notches. The median number of notches on denticulated tools is four, and the average number of notches is 4.4. These observations clearly indicate that denticulated tools contain more notches than notched tools. This is remarkable because a denticulated tool needs only two notches and a notched tool can have multiple notches, as long as they are not contiguous.

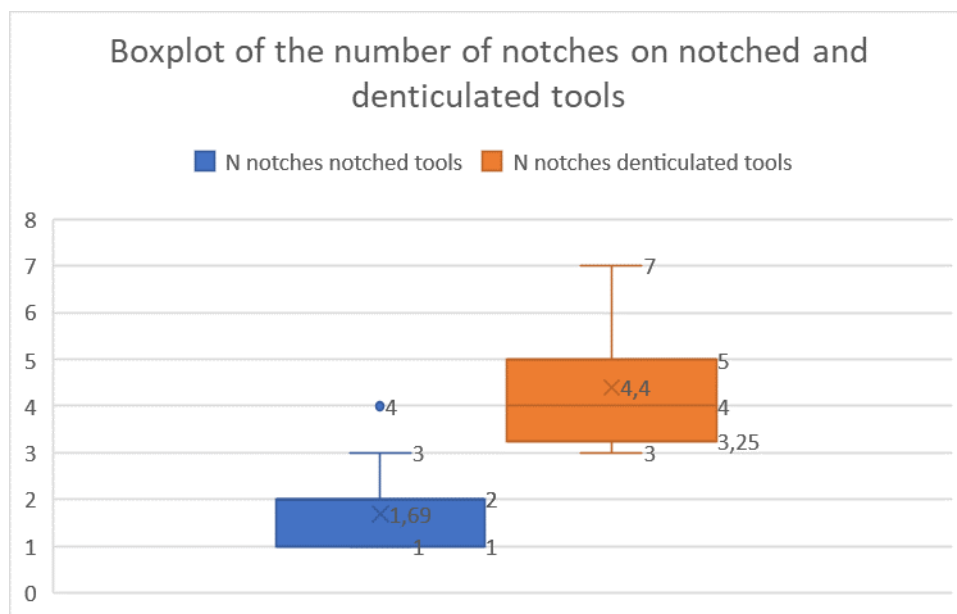


Figure 16, A boxplot with the range, median, average, outliers and most occurring 50 % of the notches per tool type.

Since denticulated tools contain at least two notches, it would be expected that these tools are bigger, since there is more space needed to place the notches. To determine if there is a clear difference in the measurements between notched and denticulated tools, table 18 presents the average and standard deviation of each type of measurement per tool type. It is important to note that the assemblage holds 149 notched tools and twenty denticulated tools. This makes it hard to make comparisons based on the measurements since there is a large margin between both sample sizes.

When comparing the average and standard deviation of the length of notched and denticulated tools, it becomes clear that there is just a slight difference between the average length. It seems that denticulated are slightly longer, by 0,6 mm. However, when looking at the standard deviation, there is a larger difference of almost 4. This indicates that the range of the length of the notched tools lies closer to each other than the length of the denticulated tools. The higher value of the standard deviation of the denticulated tools indicate that there is more variation in the length.

To determine if there is a difference in size between the width of notched and denticulated tools, the average and standard deviation of both is compared. In table 18 one can see that there is a relatively large difference between both averages. Denticulated tools seem to be 4,6 mm wider than notched tools, in this assemblage. While looking at the standard deviation, one can see that there is only a slight difference between the notched and denticulated tools. However, due to the high difference of the average, the value of the denticulated tools indicates that the measurements are very accurate and indicate that there is a high change that the denticulated tools are indeed wider than notched tools. For the notched tools the standard deviation indicates that there is not much variation between the measurements and therefore the average is quite accurate, but less than that of the denticulated tools. These observations seem to indicate that denticulated tools are in average wider than the notched tools.

When looking at the average of the thickness of notched and denticulated tools, the denticulated tools have a 2.7mm higher average. The standard deviations are quite low for both the notched and denticulated tools. This indicates that the measured values are quite consistent and therefore formed a quite reliable average. The standard deviation of the notches forms 30% of the average, and 27% for the denticulated tools. This means that with the notched tools, there is a higher change that the average changes when another measurement is added. These observations seem to indicate that denticulated tools are in average slightly thicker than the notched tools.

	Length	S.D.	Width	S.D.	Thickness	S.D.
Notched tools	38,81	9,72	36,85	8,69	15,73	4,83
Denticulated tools	39,4	13,5	41,45	8,24	17,45	4,76

Table 18, A table in which the average of the length, width and thickness in mm and the standard deviation per artifact group (notched or denticulated) are presented.

5.9 Is the placement of the notches of influence on the size of the blanks?

In the previous paragraphs we have seen that there is no correlation between the length, width or thickness of the blanks and the number of notches. However, there is a trend in the width of the blanks and the number of notches and the tools with more than four notches are thicker than the other tools. In table 19 the number of notches per edge of the artifacts are presented. This table shows that most of the notches (76%) are placed on one of the lateral edges of the artifacts.

The placement of notches can help understand the variability in the Denticulate Mousterian because a notch on the distal end will influence the length of the blank and a notch on a lateral edge will influence the width of the blank. To check if the placement of the notches influenced the dimensions of the blanks, the mean values of laterally notched and distal or proximal notched tools were calculated (Table 20). These values show that the width of laterally notched tools is narrower than distal or proximal notched tools. In both cases the thickness of the tools is comparable. When looking at the distal or proximal notched tools, the length is considerably smaller than that of the lateral notched tools. Both these outcomes are as expected, when notches are placed on the distal or proximal end of a flake, the length of the flake gets smaller every time a new notch is placed; when notches are placed on one of the lateral sides of a flake, the width of the flake decreases.

	Number of notches	Percentage
Lateral	259	76%
Distal or Proximal	77	23%
Diagonal	4	1%
Total	340	100%

Table 19, A table with the number of notches per side of the artifact and the percentage these numbers present within the total number of notches.

	Lateral	S.D.	Distal/Proximal	S.D.
Length	40,09	10,58	34,47	8,18
Width	36,15	7,90	42,30	10,06
Thickness	16,01	4,80	16,11	5,00

Table 20, A table with the mean values in mm and the standard deviation of lateral and distal/proximal notched tools.

Based on the results from the size of the tools and the number of notches, and the size of the tools and their typology it seems that the opposite of what Holdaway et al. (1996) hypothesise is true for Colmont. There is no relation between the length of the flakes and the number of notches but there seems to be a trend with the width of the flakes and the number of notches. Since the tools from all sites have been measured in the same way, the difference cannot be explained by a methodological error. Another possibility could be that at Colmont the knappers used wider flakes to place multiple notches on. Since most artifacts at Colmont are notched on a lateral side, it is a reasonable possibility that wider flakes were selected to be able to reduce the flake for a longer period of time before it became too narrow and needed to be discarded. To be able to conclude this, more research must be done about the relation between the size of the flake and the number of notches, preferably by using multiple sites in the Netherlands to determine if there is a connection for this diversion in the reduction hypothesis. Just as in the research of Holdaway et al. (1996) and Hiscock and Clarkson (2007) there is no relation between the size of the blanks and their Bordesian tool type at Colmont.

6. Conclusion

This chapter will provide an answer on the research questions that were proposed in chapter one and will then go on to discuss the applied methods and give some suggestions for future research.

At the beginning of this thesis two research questions were proposed. The first question was intended to make clear what tools were present in the assemblage of Colmont and to test two different typologies of the Denticulate Mousterian. The research question was formulated as: *What types of denticulated and notched tools are present in the assemblage following the typologies of Bordes (1961a) and Picin et al. (2011)? In which proportions do the types occur? What are the main differences between the two typologies?*

The assemblage of Colmont was assessed using two typologies. The typology of Bordes (1961a) and the typology of Picin et al. (2011). According to the typology of Bordes, the assemblage consists out of Notched tools, Denticulated tools, Tayac points and an end-notched tool. Out of the 174 artifacts, five artifacts had no notches. From the 169 tools with notches, 148 (88%) are notched tools, sixteen (9%) are denticulated tools, four are Tayac points (2%) and one (1%) is an end-notched tool. Among the denticulated tools was a small hand axe and a Quina type scraper. The typology of Picin et al. (2011) is less straight forward since the different edges of a single artifact get a type if there are notches present. On the 169 tools, 221 types of notch combinations were placed. In total the type 1Ns was recognized 66 (30%) times, 22 times on the lateral left side of an artifact, 30 times on the lateral right and fourteen times distal. The type 1Nm was present 58 (26%) times, 22 times on the lateral left, 30 times on the lateral right and six times distal. 1Nc was recognized 21 (10%) times in the assemblage, seven times on the lateral left, eight times on the lateral right and six times distal. The type 2N was present 27 (12%) times, nine times on the lateral left, ten times on the lateral right and seven times distal. The type 2-N was present eighteen (8%) times, three times on the lateral left, ten times on the lateral right and five times distal. The type Nc was present fourteen (6%) times, six times on the lateral left, three times on the lateral right and five times distal. 1N-1n was recognized twelve (5%) times, four times on the lateral left, seven times on the lateral right and one time distal. The type 1N1n was present three (1%) times, all three times on the lateral left. The type 2-N1f was present one time on the distal end of the artifact. The type 1N2n was present one time on the lateral right and the type 1N-2n was present one time on the lateral left. The main differences between the typology of Bordes (1961a) and Picin et al. (2011) is that Bordes looks at the whole tool to determine the type and Picin et al. look only at the placement of the notches per edge of an artifact. The first method is efficient to understand the whole tool but leaves no room for variation within the tool types and with only five types of tools with notches, the options are limited. The typology of Picin et al. does not say much about the artifact as a whole since only the notch combinations are described.

A second research question was used to determine what kind of flakes were used to make the tools and if there is a correlation between the tool type, or the number of notches with the kind of blank that was used. This research question was formulated as: *What are the characteristics of the blanks on which the notches and denticulates are made? Is there a correlation between the blank and the tool type? Is there a correlation between the blank and the number of notches?*

The blanks used for the tools were mostly notched on one of the lateral sides, 36% of the notches were placed on the lateral left and 40% were placed on the lateral right. 23% were notched on the distal or proximal end, but mostly distal (22%). Some tools were notched diagonally which makes up for 1%. Tools that were notched on the lateral edges were longer (40,23 mm) than tools that were notched on the distal or proximal end (34,47 mm). Tools that were notched laterally are narrower

(36,17 mm) than tools that were notched on the distal or proximal end (42,30 mm). This outcome is as expected since notches reduce the size of tools by chipping away small amounts of the blanks. Therefore, it is logical that tools with notches on their lateral side are narrower but longer than tools with notches on their distal or proximal end. There seems to be no relation between the tool type and the size of the blank. By using Bordes his typology it became clear that notched tools are longer (38,86 mm) than denticulated tools (37,44 mm), which is in contrast with the expectation that denticulated tools are longer than notched tools. The Tayac points are the longest in this assemblage with an average length of 47,25 mm. The notched tools (36,91 mm) are narrower than the denticulated tools (41,38 mm). The Tayac points (40,75) are slightly narrower than the denticulated tools, making the latter the widest tool group of this assemblage. The number of notches and the size of the blanks were also compared to test if there was a correlation. It became clear that there is no correlation between the length of the blank and the number of notches. With the width however there seems to be a trend. The tools with only one notch are the narrowest and along with the number of notches the width slightly increases up until four notches. The tools with more than four notches are slightly smaller than tools with four notches but only by 0.14 mm which could be due to the large standard deviation at four notches. The thickness of the tools is consistent with small fluctuations of circa 0,5 mm up until four notches. Tools with more than four notches are about 2 mm thicker than the other notched tools which vary between 15,5 mm and 16 mm. This increase in thickness at more than four notches could be explained by the presence of Tayac points (18,25 mm) in this group since this group is also thicker than the notched (15,77 mm) and denticulated tools (16,89 mm) in the comparison of the sizes of the Bordes types. This information led to the conclusion that at Colmont the expectation of denticulated tools, or tools with multiple notches, being longer than notched tools or tools with lesser notches, is slightly different. At Colmont tools with more notches and denticulated are wider than tools with lesser notches or the notched tools.

These observations raise some interesting questions. Are there more sites with additional groupings of notches which need other types than provided by Picin et al.? Do other sites also have tools which are wider with the more notches they contain or is Colmont the exception? To answer these questions, it would be best if more sites are researched by determining the tools according to Picin et al. (2011) their typology and compare the size of the tools with the number of notches they contain. This way it will become clear if there is a larger variability within the notch combination than Picin et al. propose, and if more sites have wider instead of longer denticulated tools in comparison with notched tools.

As has been discussed, the determination of notched and denticulated tools, but especially denticulated tools leaves very much room for the interpretation of the examiner. This makes it difficult to get the same determination for similar tools when they are determined by different people. It is likely that in this thesis also a bias in the determination record is present since in this thesis denticulated tools were interpreted as tools with a toothed edge instead of every single tool with two contiguous notches. Furthermore, this was my first time working with middle palaeolithic artifacts which likely led to certain determination flaws which would have been handled differently by more experienced researchers.

Abstract

Within the Denticulate Mousterian there is a lot of variation. There have been a lot of different explanations for this variability. Therefore, this thesis tested one of these explanations by using the Reduction hypothesis by Holdaway et al. (1996) and the implementation of this hypothesis by Hiscock and Clarkson (2007). There has also been debate about the typology of Bordes (1961a) and its capability to describe the variability of the tools, therefore Picin et al. (2011) proposed a new type of typology. Both these typologies were applied in the determination of the artifacts from Colmont and compared on their ability to describe the tools and their variability. The two main questions that are answered in this research are:

1. *What types of denticulated and notched tools are present in the assemblage following the typologies of Bordes (1961a) and Picin et al. (2011)? In which proportions do the types occur? What are the main differences between the two typologies?*
2. *What are the characteristics of the blanks on which the notches and denticulates are made? Is there a correlation between the blank and the tool type? Is there a correlation between the blank and the number of notches?*

The first question is answered by using both typologies to determine the artifacts and processing the data in a database. This way percentages could be calculated and both typologies were easily comparable. It became clear the notched tools were the largest tool group of the assemblage, followed by the denticulated tools. The main difference between both typologies is that Bordes his typology focusses on the entire artifact and the typology of Picin et al. focusses on the placement of notches on different edges of an artifact. The second question is answered by calculating the mean length, width and thickness of the artifacts per number of notches and per artifact group. This way it became clear that there was a trend in the thickness and the number of notches, and not with the length or the different tool types.

Additional research is necessary to test if the results of this research are similar with other assemblages. There is a lot of variability within the placement of notches, therefore the typology of Picin et al. (2011) needs to be elaborated with more options and tested with more assemblages. Also, the reduction hypothesis of Holdaway et al. (1996) proved to be different at Colmont. Not the length of the blank is related to the number of notches, but the width of the blank. Therefore, more sites need to be researched using this hypothesis to determine if Colmont is the exception in the rule or if there are different types of preferences for blank sizes.

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