Journal of Archaeological Science: Reports 50 (2023) 104066

Contents lists available at ScienceDirect

Journal of Archaeological Science: Reports

journal homepage: www.elsevier.com/locate/jasrep

New insight into prehistoric craft specialisation. Tooth-tool use in the Chalcolithic burial site of Camino del Molino, Murcia, SE Spain

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ARTICLE INFO

Keywords:
Osteoarchaeology
Prehistory
Copper age
Dental wear
Craft Specialisation
Sex-based division of labour

ABSTRACT

The study of non-alimentary tooth wear is an excellent tool to identify the development of specific activities and thus, to delve deeper into the social organisation and complexity of past populations. This paper analyses extra-masticatory wear in the dentition of a sample of 102 articulated skeletons from Camino del Molino, a unique collective tomb that housed 1,348 individuals throughout two contiguous phases spanning much of the 3rd millennium BC. After preliminary macroscopic observation of the dental sample, 8 individuals with cultural dental wear were identified and 5 of them were analysed with SEM. In all cases, the maxillary anterior dentition displays evidence that can be defined as occlusal and interproximal grooves consisting of fine, parallel striations, as well as labial notches and chipping of the enamel. The results suggest that 8 individuals, mostly women, used their dentition in craft tasks, such as in the processing of fibres for textile production, hence representing the earliest evidence of craft specialisation in the Iberian Peninsula and potential proof of a possible sex-based division of labour in a Chalcolithic community.

1. Introduction

The Iberian Copper Age is characterised by the emergence of a new type of large-scale sites, more complex than previous settlements, with a notable increase in the size and a significant investment in defensive architectural structures (Sangmeister and Schubart, 1972; Hurtado, 1997; Zafra et al., 2003; Molina and Cámara, 2010; Valera et al., 2014; García San Juan et al., 2017). This evidence, together with other factors such as agricultural intensification, demographic increase, population aggregation and political centralisation, reflects the development of the first complex societies (Aranda et al., 2017). These processes were accompanied by an intensification of funerary activity, in which tombs of various types –megalithic tombs, natural caves, artificial caves or hypogeum and negative structures– were built. Most of the Iberian funerary finds from the 3rd millennium are located close to sites identified as settlements and around the main riverbeds. In the southeast, cemeteries with collective tholos-type (*e.g.*, Leisner and Leisner, 1943; Peña, 2011; Díaz-Zorita et al., 2016) or passage tombs (*e.g.*, Díaz-Zorita Bonilla et al., 2017a; García Sánchez, 1961; Lomba Maurandi, 1999; Vílchez et al., 2023) are the most common.

1.1. The site

The collective burial site at Camino del Molino (CMOL) (Fig. 1), was discovered by chance in 2007 in the midst of a construction project, and emergency excavation was conducted throughout 2008 (Lomba et al., 2009a; Lomba et al., 2009b). The site is located in Caravaca de la Cruz, a municipality in the northwest of the Region of Murcia (Fig. 1b), surrounded from west to east by the Argos and Quípar rivers. This site is part of the Subbaetic system and has a very rugged relief and a high altitude, over 800 m in most of its territory (Fig. 1c).

The grave can be defined as a circular structure carved into the travertine with slightly flared walls and a diameter of about 6–7 m, of which the lower 2 m where the archaeological deposit accumulated have been preserved (Lomba et al., 2009a, 2009b) (Fig. 2a and 2b). The geomorphological analysis indicates that while this pit formed part of a cave, there is clear anthropic alteration both on the walls and observed in the picketing of the floor, which prompts us to suggest that it was originally an artificial cave or hypogeum with an entrance in the upper part and a perishable structure as support, of which only the post holes are preserved (Díaz-Navarro, 2023). It is a funerary structure well identified in the Iberian record of the 3rd millennium BC (*e.g.,* Nieto,

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https://doi.org/10.1016/j.jasrep.2023.104066
Received 4 April 2023; Received in revised form 31 May 2023; Accepted 1 June 2023
Available online 9 June 2023

1959; Silva, 1998, 2012, 2019; Mercadal et al., 2005; Francès et al., 2007; Rivera García, 2011; Balaguer et al., 2015; Beck, 2016; Bueno et al., 2017). These are primary and predominantly collective burials and are characterised by the development of successive individual depositions that require conditioning and variations of the grave due to their prolonged use.

The sequence of CMOL is characterised by the repeated introduction of corpses, in many cases simultaneously, which were grouped around the walls of the structure as the space filled up (Fig. 2b) (Haber et al., 2012; Díaz-Navarro, 2023). Some individuals were recovered in perfect anatomical connection, others were in the form of skeletal packages, and others were completely isolated remains as a consequence of the continuous removal and relocation of corpses (Fig. 2b and 2c).

Anthropological research has identified a minimum number of 1,348 individuals, making CMOL the largest prehistoric burial site known to date (Díaz-Navarro, 2023). The deposited population consisted of individuals of all ages and both sexes equally represented, so it appears to be an accurate representation of a Chalcolithic population (Table 1). The C14 dating of 28 articulated skeletons has allowed us to identify two possible contiguous funerary phases (Table 1) covering almost the entire 3rd millennium BC (2971-2711-2451-2251 years cal. BC, 2σ) (Díaz-Navarro, 2023).

To understand the magnitude of this tomb, it is necessary to investigate the funerary record of other contemporary sites. In Europe, although there are collective burials with a large number of individuals, such as the hypogeum of Crottes in Roaix (MNI 136, Chambon, 2003), or the hypogeum of Boileau in Vaucluse (MNI 350, Mahieu 1987), none come close to the size of CMOL. Other tombs with a large volume of human remains have also been identified in the Iberian Peninsula (Mercadal et al., 2005; Etxeberria and Herrasti, 2007; Silva, 2012; Balaguer et al., 2015; Díaz-Zorita et al., 2017b), although in no case do these graves exceed 500 individuals. The exceptional nature of the site lies not only in the size of the skeletal series, but also in the excellent conservation of the skeletal remains and the preservation of a large sample of articulated individuals. This is unusual for 3rd millennium collective tombs, which generally have reduced or displaced primary deposits –in which the remains undergo continuous removal once they have been skeletonised–. These aspects make CMOL a reference osteological collection for the study of prehistoric populations.

This paper analyses the sample of articulated CMOL skeletons with associated dentition in order to identify and characterise the extramasticatory uses of the dentition and the patterns of tooth affectation, considering the distribution of affected individuals by age and sex. In this way, we can see a more complete picture of specialisation in economic tasks and, thus, of social organisation in a Mediterranean Chalcolithic community.

2. Materials and methods

2.1. Materials

The CMOL NMI amounts to 1,348 individuals including the skulls (Díaz-Navarro, 2023). Of these, 167 are articulated skeletons (12.4%) (Fig. 1c). The remains analysed in this work correspond to the 102 articulated skeletons that preserved associated dentition, representing 61% of the sample of articulated skeletons and 7.5% of the total estimated population (Table 1). In total, this preserved dentition included 1,982 teeth −221 central incisors, 233 lateral incisors, 224 canines, 229 first premolars, 256 second premolars, 291 first molars, 281 second molars and 247 third molars, thus constituting 51.1% of the maxillary dentition and 48.9% of the lower dentition.

Of this sample, 8.8% died at 0–6 years of age, 7.8% at 7–12 years, 8.8% at 13–20 years, 38.2% at 21–39 years, and the remaining 36.3% at 40–59 years. In terms of sex, 46.1% were female, 25.5% male, 4.9% were likely female, 2% were likely male, and 21.6% were of undetermined sex because they were non-adult individuals or because the skull and/or pelvis were not preserved.

2.2. Methods

The methodology used in sex estimation was the analysis of pelvic and cranial morphology (Buikstra and Ubelaker, 1994; Herrmann et al., 1990). Combined analysis of the metamorphosis of the pubic symphysis and auricular facet (Meindl et al., 1985; Lovejoy et al., 1985), as well as the sternal end of the fourth rib (Işcan et al., 1985a, 1985b), were used to determine age at death. In non-adults, the degree of dental eruption (AlQahtani et al., 2010) and epiphyseal fusion were analysed (Scheuer and Black, 2000; Szilvássy, 1977).

Macroscopic degree of occlusal attrition was scored following Smith (1984). Dental and alveolar pathologies were recorded to establish possible relationships between non-alimentary tooth use and the presence of some pathologies. The presence/absence of caries, dental

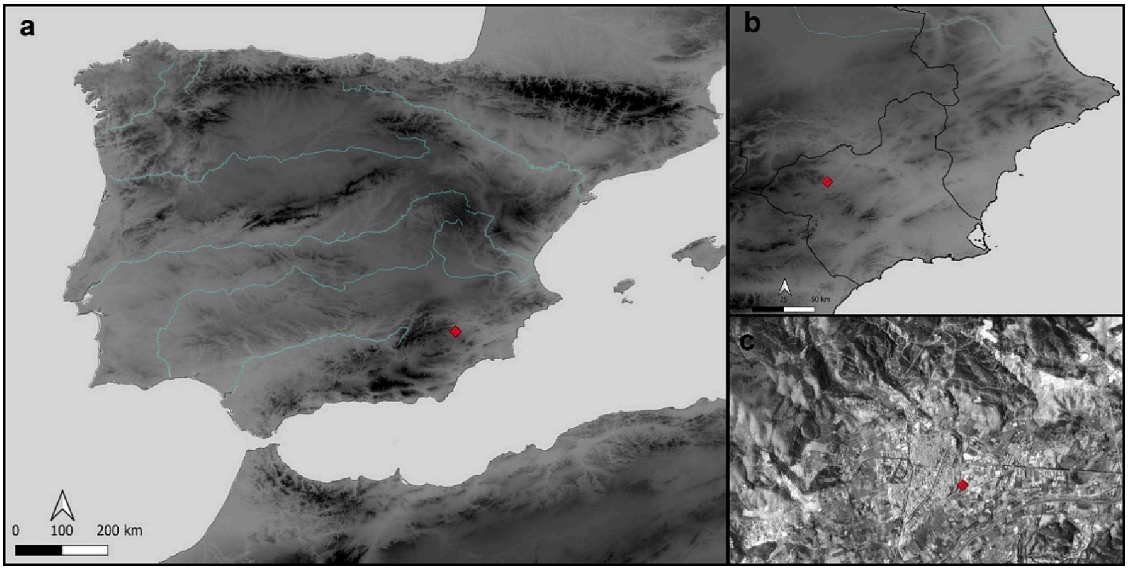

Fig. 1. Location of the site under study (QGIS, 3.16 Hannover). a. Iberian Peninsula Map showing the location of the burial site of Camino del Molino, at SE Spain. b. Location of Camino del Molino in the present-day Region of Murcia. c. Aerial photograph of Caravaca de la Cruz.

calculus and periodontal disease was recorded following standards in the literature (Buikstra and Ubelaker, 1994; Lavigne and Molto, 1995; Hillson, 2001).

A preliminary macroscopic observation of the dental sample of the 102 articulated skeletons was carried out to identify possible cultural dental wear. Traces of extra-masticatory wear were observed in 8 maxillae.

The labial and occlusal surfaces of 13 teeth belonging to five different maxillae (S9, S30, S41, S63 and S133) were examined microscopically to establish the para-masticatory use of the anterior teeth. These teeth were imaged using a Scanning electron Microscope (SEM) JEOL JSM-6460LV in vacuum mode. Thus, prior to imaging the teeth, we created a gold-coated high-resolution replica of the originals. The standard protocol for creating these replicas involves several steps. First, teeth were cleaned twice with ethanol to remove contaminants from the labial and occlusal surfaces. Second, an impression of the labial or occlusal surface was taken using a rubber-based, addition-curing silicone (Coltène; President Jet, lightbody®). These silicone replicas were used to produce a cast using an epoxy resin, which was coated for 3 min with a fine layer of gold.

Digitized images were taken at different magnifications, from 12X to 500X.

The teeth were photographed in detail with a TAMRON macro 90 mm SP lens attached to a NIKON D750 camera.

Finally, we have assessed the origin of the individuals analysed, using the results of the $^{87}Sr/^{86}Sr$ isotopic mobility analysis carried out on dental enamel from 93 individuals from CMOL (Merner, 2017), which points to the presence of 12 non-local individuals (12.9%).

Table 1
Sex and age composition of the population of Camino del Molino.

Age and sex groups	Representation		
	Burial Phase I	Burial Phase II	Total
Infants (0–12 years)	25.6%	24.3%	24.8%
Juveniles (13–20 years)	7%	5.2%	5.9%
Young adults (21–39 years)	33.3%	29.7%	30.9%
Middle-aged adults (40–59 years)	30.7%	36.9%	34.7%
Elderly adults (>60 years)	3.4%	3.9%	3.7%
Females	27.9%	28%	27.9%
Males	29.7%	31%	28.9%
Probably females	4.6%	4.3%	4.8%
Probably males	4.6%	4.5%	4.7%
Unknown sex	33.2%	32.2%	33.7%

3. Results

Macroscopic analysis of the teeth for the CMOL articulated skeletons suggests the presence of eight individuals with atypical dental wear, all of them deposited in the southeastern corner of the funerary space (Table 2; Fig. 2c).

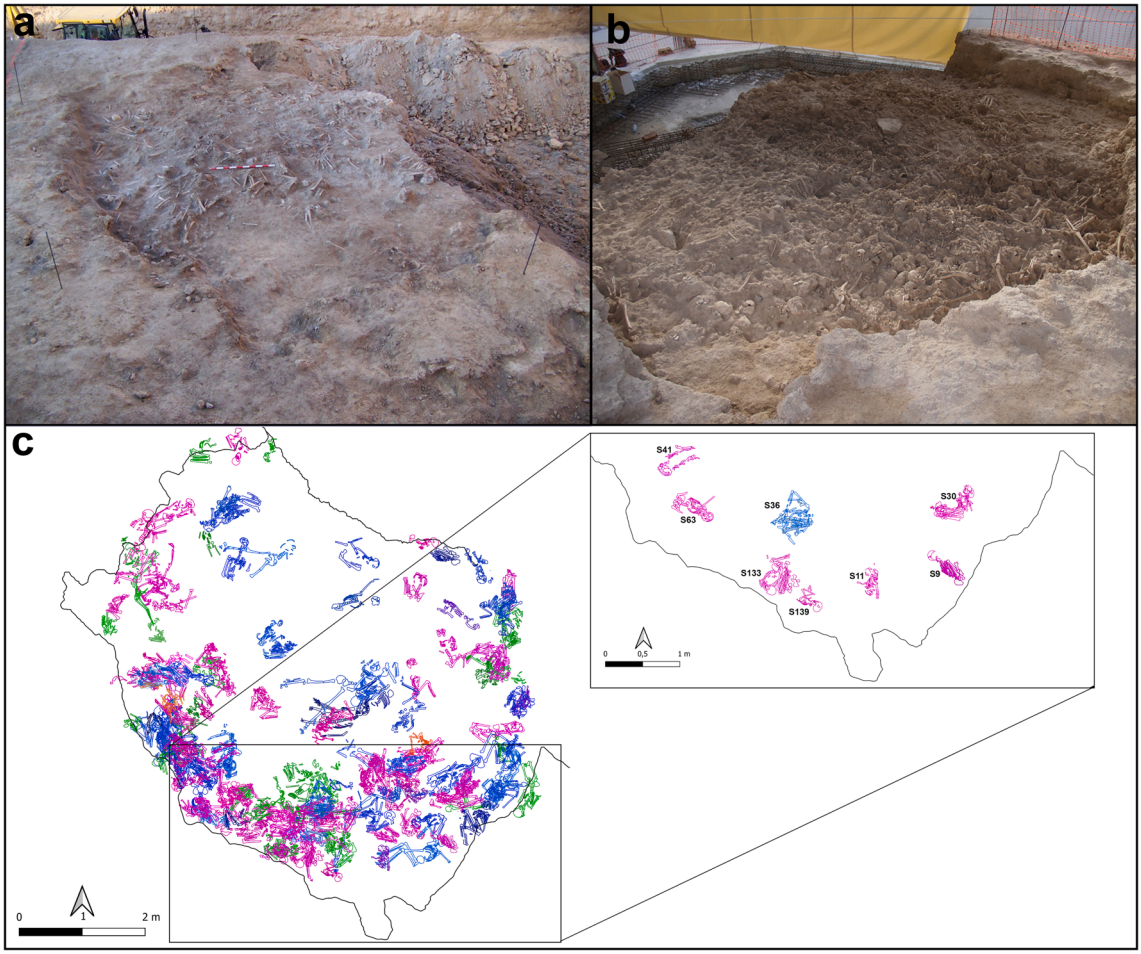

Fig 2. Collective burial of Camino del Molino (Caravaca de la Cruz, Murcia). a. Photograph taken after surface cleaning. b. Photograph during excavation. c. Digital planimetry (QGIS 3.16.6 Hannover) of the articulated skeletons and detail of the south-eastern area of the burial where the individuals involved in this study were deposited. Females are marked in pink, probably females in purple, males in blue, probably males in dark blue, skeletons of unknown sex in orange, and non-adults in green. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Table 2
Detail of CMOL individuals with abnormal wear due to the use of the mouth in extra-masticatory activities (F: female, M: male, J: juvenile, YA: young adults, MA: middle-aged adults, ATWD: Anterior Teeth Wear Degree, C: Caries, AMTL: Antemortem Tooth Loss, PD: Periodontal Disease, DC: Dental Calculus). The numbers below the tooth abbreviation are FDI.

Skeleton no.	Burial phase	Sex	Age	87Sr/86Sr results (Merner, 2017)	ATWD (Smith, 1984)	Oral pathologies	Tooth affected by extra-masticatory wear	Type of extra-masticatory wear	Area affected by grooves
Microscopic analysis									
S9	2nd phase	F	MA	Non-local	7	C 22–24, 12–13 AMTL 14–18, 35–38, 45–48. Advanced PD	12	Groove and enamel chipping	Interproximal distolingual Surface
S30	2nd phase	F	MA	Local	6	AMTL14-15, 35–36, 45–48. Moderate PD	21	Groove	Interproximal distolingual surface
S41	2nd phase	F	MA	Non-local	7–8	C 14, 15, 25–26, AMTL 16–18, 27–28, 36, 46. Medium DC Advanced PD	11, 12, 21, 22	Grooves, notches and chipping	Interproximal mesiolingual surface
S63	2nd phase	F	J	Local	6	C 25–26.	12	Groove	Occlusal surface
S133	1st phase	F	YA	Local	5	C 16, 26, 35, 37. AMTL 14, 36 Mild PD	11, 12, 21, 22	Grooves and notches	Occlusal surface
Macroscopic analysis									
S11	2nd phase	F	YA	Non-local	5	Mild DC and PD	21	Groove	Occlusal surface
S36	2nd phase	M	MA	–	6	AMTL 26–28, 14–18 Moderate DC and PD	21	Groove	Interproximal mesiolingual surface
S139	1st phase	F	YA	Local	6	Medium DC. Moderate PD	21, 22	Groove	Labial surface

3.1. Microscopically analysed teeth

The individual S9 is a middle-aged female (36–50 years old) who was deposited in left lateral decubitus during the second burial phase. The maxilla is preserved with the anterior dentition and tooth no. 24. The mandible retains teeth nos. 31–34 and 41–44. This individual's palatal dentition exhibits pronounced wear and has exposed dentine on the entire lingual surface (Fig. 3e). When analysing her tooth no.12 in the SEM, we identified a curved interproximal groove on the distal third of the crown, which crosses the distolingual surface perpendicularly (Fig. 4a). When the image is enlarged (x170), numerous fine, parallel, labio-lingually oriented striae can be observed throughout the entire surface of the groove. Shorter and slightly deeper striae extend beyond the contour of the groove (Fig. 4a). In addition, enamel chipping has been documented on the labial surface of the central incisors (11, 21) (Fig. 5). There are no macroscopic traces of extra-masticatory wear on the mandibular anterior teeth.

The S30 articulated skeleton is a middle-aged female (36–50 years old) deposited in left lateral decubitus during the second burial phase. The mandible is preserved without teeth. Of the maxillary dentition only teeth nos. 21–22 and 24 are *in situ*. The tooth no. 21 shows a curvilinear interproximal groove, perpendicular to the tooth axis, located in the cervical third, involving the distal and lingual areas (Fig. 3d). When analysing this piece in the SEM, we corroborated the extra-masticatory character of the groove, which acquires a canal shape with wavy margins. At 500x, the multiple long, thin, V-section and distolabially to distolingually-oriented striae are clearly visible (Fig. 4b).

The dentition of S41, a mature woman (45–60 years old) placed in left lateral decubitus in the second level of use, stands out. Her maxilla currently preserves teeth nos. 11–12, 14, 21–22 and 24–26 and her mandible teeth nos. 34–35, 37–38, 44–45 and 47–48. Her upper dentition exhibits severe dental wear that almost reaches the root of the central incisors (Fig. 3h). In the interproximal area of the tooth no. 11, almost at the level of the cervix, there is a deep and well-delimited groove involving the lingual and mesial areas. The groove is formed by striae that are identical to those observed in the previous individuals (elongated and parallel) and is mesiolabially to mesiolingually oriented (Fig. 6a). The tooth no. 12 (Fig. 6b) also exhibits a new interproximal groove on the cervical third of the mesiolingual surface of the crown. The 130x view once again shows the same pattern of striae. On the other hand, although the tooth no. 21 shows evident notches and chipping in the enamel preserved on the labial surface, its high level of wear does not allow us to identify striations as in the rest of the incisors. Microscopically, wavy facets are observed on the cervical third of the crown, possibly related to irregular occlusal wear and occlusion with the mandibular teeth (Fig. 6c). There are also notches on teeth no. 21 (Fig. 6c) and chipping of the preserved enamel on the labial surface of all upper incisors (Fig. 3h).

Skeleton S63 is a female who died as a juvenile (17–19 years old). She was deposited in the second level of funerary use in supine decubitus with her legs hyperflexed. The maxilla and mandible are preserved without teeth lost. There is anomalous wear on the tooth no.12 (Fig. 3g). Macroscopically, a deep, well-defined, curvilinear interproximal groove can be identified, which crosses part of the distolingual surface on the distal third of the crown. When analysing this tooth in the SEM, the striae forming the groove are clearly visible, elongated, thin, and parallel, following a direction perpendicular to the axis of the tooth –distolabially to distolingually-oriented– (Fig. 3c). It also exhibits a notch on the mesiolingual surface of the same tooth and enamel chipping on the teeth nos. 12 and 22. There are no macroscopic traces of extra-masticatory wear on the mandibular anterior teeth.

The individual S133 is a young adult female (20–24 years old) who was deposited during the first funerary phase in a hyperflexed supine decubitus position. All of this individual's dentition is preserved, with the exception of the anterior mandibular teeth, that were lost after death. In the anterior palatine dentition, two new rounded grooves on the occlusal surface are visible (Fig. 3b and Fig. 7). The first one is located on the tooth no.12, crossing the enamel and exposing dentine of the occlusal surface and is labiolingually oriented (Fig. 7). A second groove has been identified in the same area, but on the tooth no.22. Both have the same length, although the one on the left side is not as deep. Up to eight notches have also been verified on the incisal surface of the central and lateral incisors.

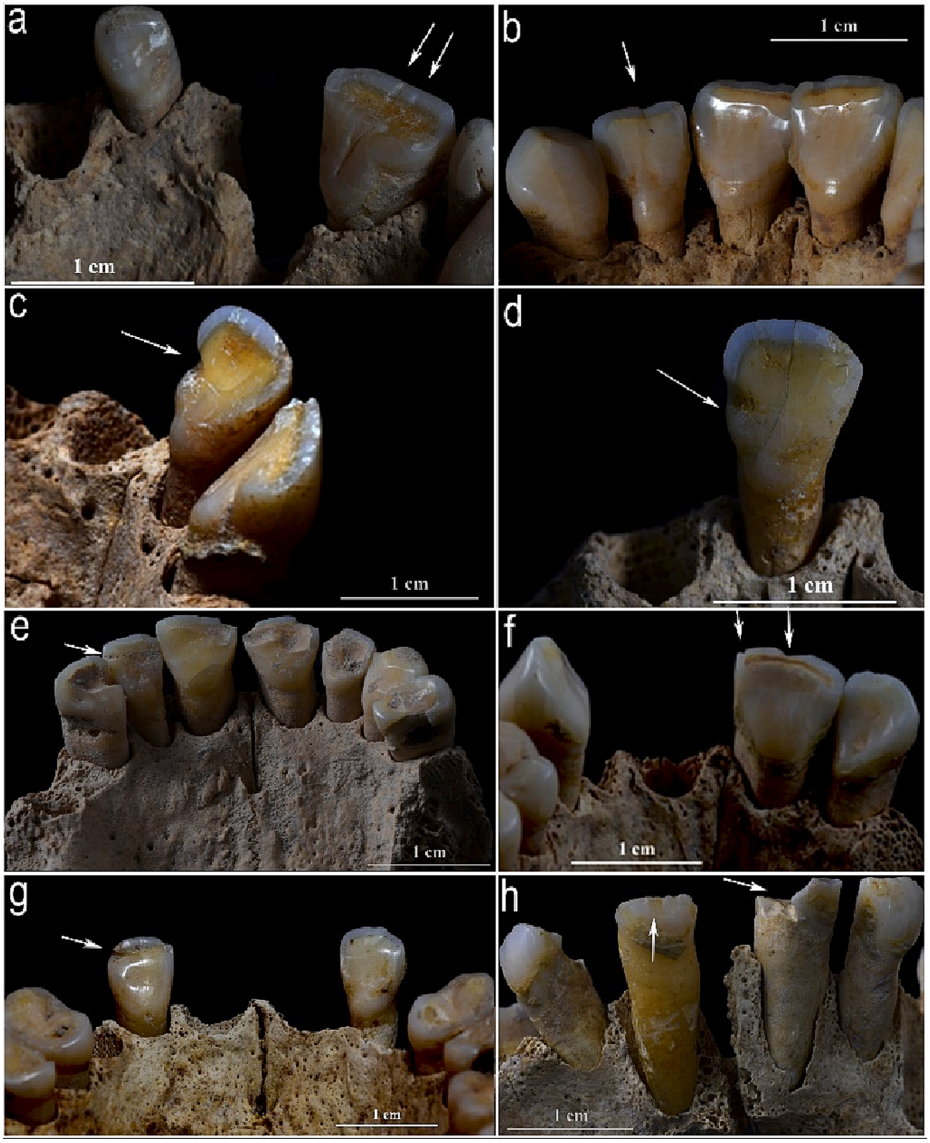

Fig. 3. Extra-masticatory wear in CMOL. a. Detail of the upper left central incisor of S11. b. Maxilla of S133. c. Detail of the teeth nos. 21 and 22 of S36. d. Tooth no. 21 of S30. e. Maxilla of S9. f. Detail of the upper incisors of S139. g. Detail of anterior dentition of S63. h. Labial view of the upper incisors of S41.

3.2. Macroscopically analysed teeth

In addition, related grooves, notches, and enamel chipping have also been macroscopically identified on the central and lateral incisors of three more individuals.

The individual S11 is a young adult female (30–39 years old) deposited in a supine position in the second funerary phase. In terms of this individual's mandibular dentition, teeth nos. 42–44 and 46–47 are preserved. In the maxillary dentition, all teeth are preserved except the teeth nos. 11, and 26–28 14–15, 18, which were lost postmortem. The tooth no. 21 (Fig. 3a) displays two parallel grooves on the occlusal surface, both running perpendicularly across the centre of it. These have a morphology similar to that identified in S133 (Fig. 7). There are no macroscopic traces of extra-masticatory wear on the mandibular anterior teeth.

Skeleton S36 is a middle-aged male individual (36–50 years old) positioned in prone decubitus in the second level of funerary use. In this case, the cranium was not articulated with the rest of the skeleton, so the association of the maxilla to this individual is not as reliable as in the rest of the articulated skeletons. Only the maxillary dentition is preserved, specifically the teeth nos. 21–22 and 25. The tooth no. 21 exhibits a large interproximal groove perpendicular to the axis of the tooth located in the cervical third and involves the distal and lingual areas (Fig. 3c), thus exhibiting a similar morphology to S9 and S30 (Fig. 4).

The last evidence is identified in the skeleton S139, a young woman (25–30 years old) deposited in right lateral decubitus in the first level of funerary use. Of the lower dentition, only the teeth nos. 36, 38, 46, 48 and 45 have been preserved, while the rest were lost postmortem. Of the palatine bone, only the right half –minus the teeth nos. 11–12 due to their postmortem loss– and the left incisors (21–22) is preserved. In the tooth no. 21, there are two clear notches, one in the mesial and one in the central area of the incisal surface, as well as three more in the mesial area of the tooth no. 22 (Fig. 3f).

Therefore, interproximal and occlusal grooves, notches on the incisal surface, and enamel chipping are identified in eight individuals (Table 2). The described marks are found in the maxillary anterior dentition in 100% of cases. We identified grooves on four central incisors and five lateral incisors, corresponding to seven individuals (88%), notches on four central incisors and four lateral incisors for four individuals (50%), and enamel chipping on four central incisors and four lateral incisors for three individuals (38%). Four individuals (50%) exhibit grooves on the right incisors and the same number have them on

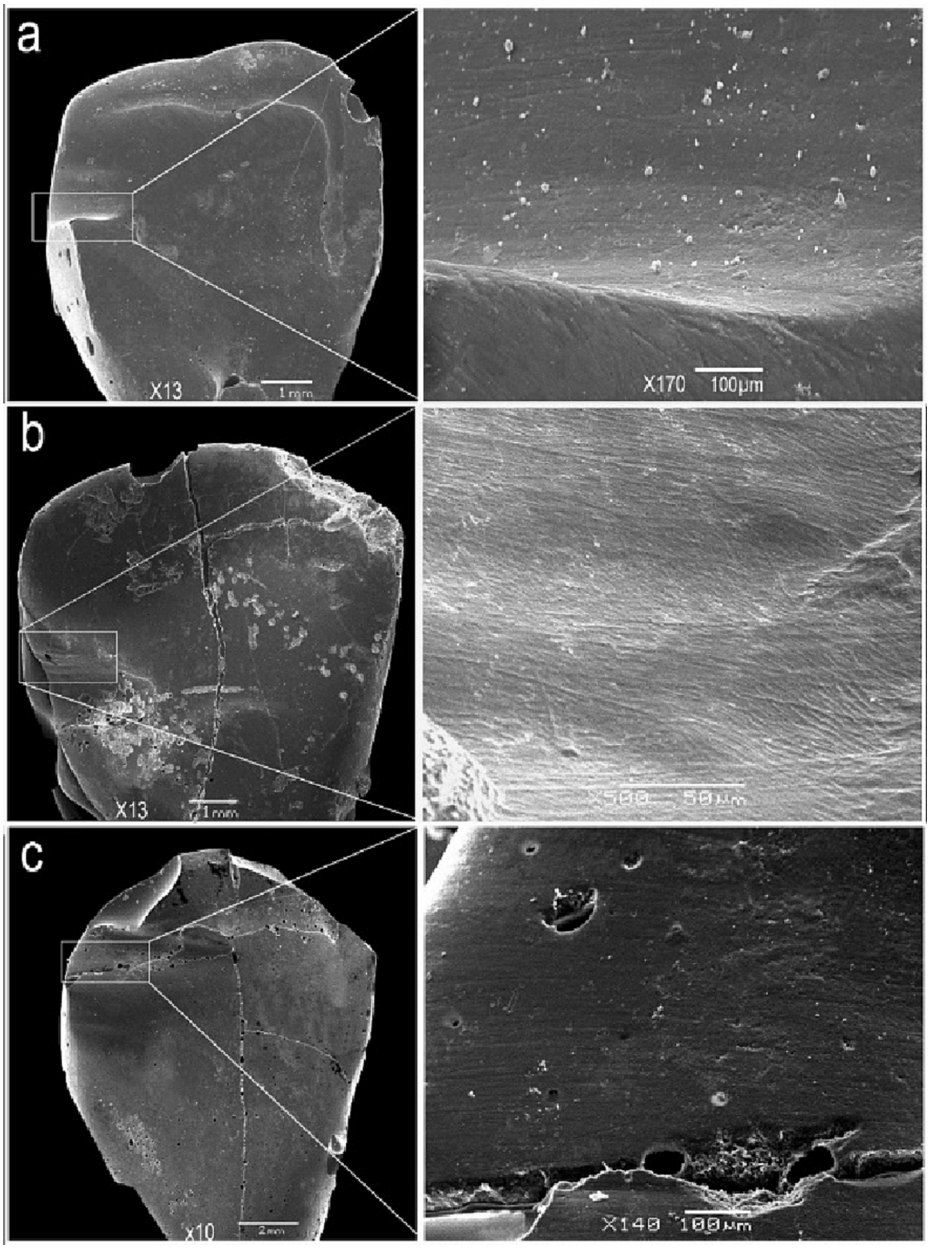

Fig. 4. SEM images of some of the evidence of extra-masticatory wear. a. Interproximal groove in tooth no. 12 of S9 (x13 vs. x170). b. Interproximal groove in tooth no. 21 of S30 (x12 vs x500x). c. Interproximal groove in tooth no. 12 of S63 (x10 vs. x140). The presence of parallel microstriations in the detailed photographs is noteworthy.

the left.

Finally, some dental and oral pathologies are documented among these eight individuals, such as antemortem teeth loss, caries, dental calculus and periodontal disease (Table 2). In this regard, it should be noted that 51.9% of the articulated skeletons with associated dentition present dental caries –located mainly in the mesial and distal interproximal areas of the neck (38%) and the crown (30.6%) of posterior teeth (94.2%)–; 62.4% exhibit calculus deposits –65.1% mild, 25.4% medium and 9.5% moderate–; 41% of individuals suffered antemortem tooth loss; and 67.6% periodontal disease –21.8% mild, 24.7% moderate and 21.8% advanced–. Therefore, we cannot establish a relationship between the use of the dentition in extra-masticatory activities and the development of oral pathological processes.

4. Discussion

Numerous studies have recorded various dental modifications, mainly related to the processing of animal or plant fibres (*e.g.*, Lous, 1970; Schulz, 1977; Larsen, 1985; Lukacs and Pastor, 1988; Brown and Molnar, 1990; Lalueza-Fox and Frayer, 1997; Lozano et al., 2008, 2017, 2021; Frayer et al., 2010; Estalrrich and Rosas, 2013; Estalrrich and Marín-Arroyo, 2021) or hygienic practices (*e.g.*, Frayer and Russell, 1987; Estalrrich et al., 2017; Willman et al., 2019). Occlusal and paraocclusal grooves are the most commonly described in past populations, usually affecting incisors and canines, and have been mainly related to fibre manipulation (Larsen, 1985; Frayer and Minozzi, 2002; Minozzi et al., 2003; Bocquentin et al., 2005; Erdal, 2008; Waters-Rist et al., 2010; Lorkiewicz, 2011; Sperduti et al., 2018; Lozano et al., 2021) based on ethnographic and experimental studies (Schulz, 1977; Erdal, 2008; Scott and Jolie, 2008; Vogeikoff-Brogan and Smith, 2010; Porras et al.,

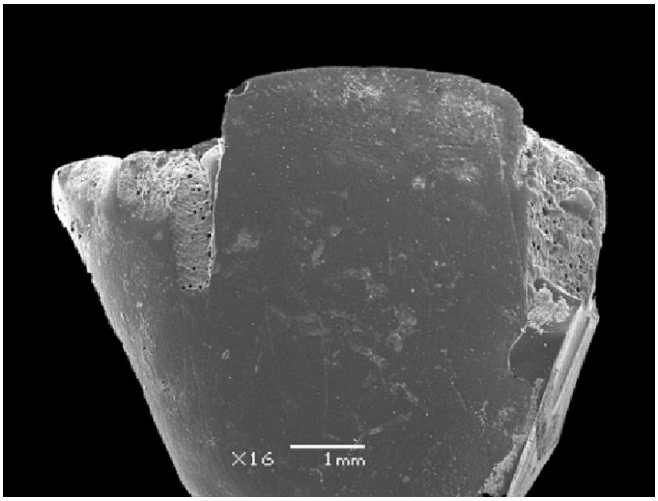

Fig. 5. Enamel chipping. Labial surface of the tooth no. 21 of S9.

2013).

In CMOL, eight individuals exhibit cultural wear that can be defined by the presence of interproximal or occlusal grooves that can be oriented distolingually, mesiolingually or labiolingually, consisting of generally elongated and V-section grooves and associated with notches on the incisal surface and enamel chipping.

Grooves, notches, and chipping always appear in the maxillary dentition, involving both right and left central and lateral incisors. Notching is defined as an indentation at the incisal or occlusal edge, which may extend over the entire occlusal surface, while chipping is an irregular microfracture of the enamel or dentine at the tooth margins (Bonfiglioli et al., 2004). Both have been related to high biting forces in frequent contact with hard objects, such as needles, while using both hands (Turner and Anderson, 2003; Scott and Jolie, 2008; Scott and Winn, 2011; Lozano et al., 2021).

The location of the grooves and the micro-striations that form them are consistent with the hypothesis of the manipulation of plant fibres to produce yarns (Bocquentin et al., 2005; Bonfiglioli et al., 2004; Scott and Jolie, 2008; Sperduti et al., 2018). The characteristics of the grooves point to small-sized yarns, originating from fibres such as hemp. Experimental studies (Porras et al., 2013) have shown that other materials, such as wicker, produce deep and non-parallel striations due to their hardness and irregularity, while tendon leaves hardly any evidence of striations. The occlusal grooves identified here are located in the central area of the teeth, running perpendicularly across the occlusal surface. The interproximal grooves are generally visible at mid-crown height on the mesial and distal interproximal surface and only in one case (S41) run along the cemento-enamel junction. In all cases, the curvature of the sulcus points to the manipulation of flexible materials,

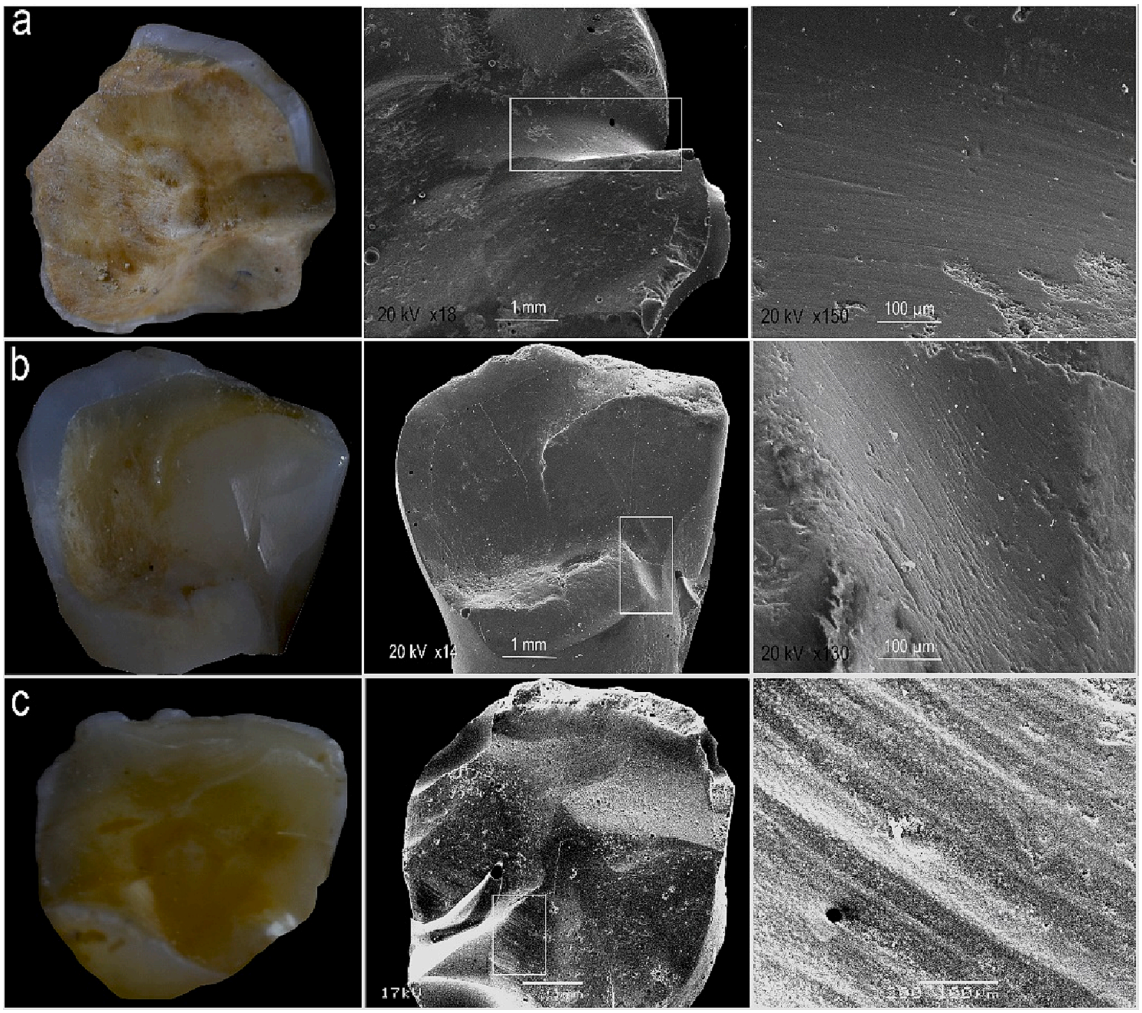

Fig. 6. Extra-masticatory wear of S41. a. Tooth no. 11 and SEM detail of the groove and the striae that form it. b. Tooth no. 12. The presence of parallel microstratification in the detailed photographs is once again noteworthy. c. Tooth no. 21. In this case, the wavy facets observed must be related to irregular occlusal wear and occlusion with the mandibular teeth.

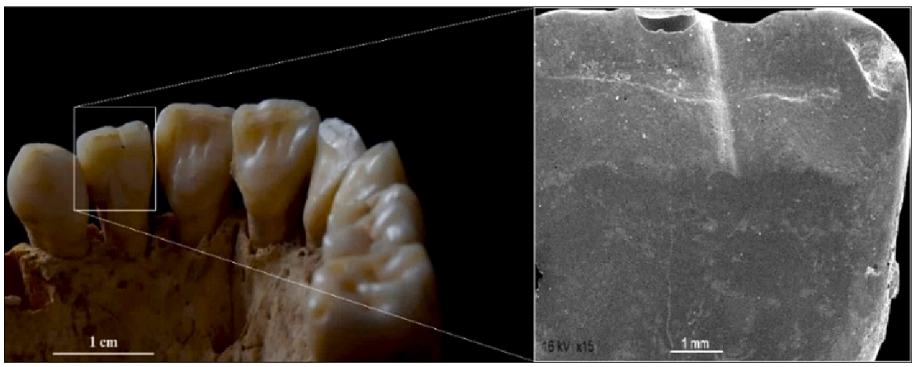

Fig. 7. Occlusal grooves of S133. Left: Maxilla showing two occlusal grooves on the teeth nos. 22 and 12. Right: Microscopic SEM detail (x15) of the tooth no.12 showing the aforementioned groove running perpendicularly across the occlusal surface.

so we rule out that they are a product of the use of toothpicks or other rigid materials (Estalrrich et al., 2017; Willman et al., 2019).

Therefore, all the evidence seems to point to the fact that certain CMOL individuals held some object with their mouths that caused enamel chipping in the labial surface of the anterior teeth, while they used the interproximal and occlusal surface of the incisors to repeatedly drag some kind of fine plant tissue. No preference for laterality or incisor type can be established, as left and right, central and lateral incisors are equally involved.

It is also difficult to discern the exact activity carried out by CMOL individuals, as there is no evidence of this type of craft activity in the grave's archaeological record, where the presence of offerings or grave goods can also be described as insignificant. The only noteworthy aspect is the record of 17 metal awls and 30 bone awls and rods (Lomba et al., 2009b; Lomba et al., 2009a). It should be noted that a Chalcolithic settlement –Molinos de Papel– is located just 400 m from the CMOL burial site and is characterised by the presence of structures carved into the rock, such as silos, hut floors, and two ditch-like structures. Although this site is still under study, the use of reeds, twigs, and plant fibres in the covering of the huts has been suggested, as well as the use of basketry imprints at the base of the ceramic vessels, where knots and multiple lattices can be seen (Pujante, 1999). In other areas of the southern peninsula, there are prehistoric archaeological records of fibres, such as flax, wool or hemp, basketry, cords, and associated materials, such as awls or needles (Molina et al., 2003; Ayala and Jiménez, 2007; Aranda et al., 2009; Bottaini et al., 2014).

The use of dentition as a tool or "third hand" in crafts involving threads has also been found in other prehistoric samples. A very similar wear pattern was identified in other populations from the Iberian southeast, such as the Argaric series from Granada (Lozano et al., 2021; Rubio, 2021). The macroscopic appearance of these marks is very similar to that observed in CMOL, although in some dental pieces the interproximal grooves are larger and deeper, which could indicate the use of thicker materials, such as tendons, leather, or wool (Lozano et al., 2021; Rubio, 2021), as opposed to the use of finer plant fibres, which was widespread in CMOL. Other related evidence has been identified in prehistoric series from Poland (Lorkiewicz, 2011), Syria (Molleston, 2016), Pakistan (Lukacs and Pastor, 1988), Italy (Sperduti et al., 2018), Germany (Alt and Pichler,1998) and Portugal (Fidalgo et al., 2020; Willman et al., 2021). This practice is also found in historical times, such as in medieval Nordic (Scott and Jolie, 2008), British (Cruwys et al., 1992), Anatolian (Erdal, 2008), or Italian (Monaco et al., 2022; Trombley et al., 2018) osteological collections. On the American continent, similar markings have been identified in prehistoric populations from California (Schulz, 1977), the Western Great Basin (Larsen, 1985) and Texas (Bement, 1994), precontact British Columbia (Cybulski, 1974), historic Cherokee Indians (Owsley and Bellande, 1982) and the Caribbean (Larsen et al., 1998).

There are other sources that attest to this work in Prehistory and Antiquity, such as iconographic representations in Egyptian tombs from the 3rd millennium depicting young artisans working with thread (Harrington, 2018) or the Orvieto kylix depicting a young woman spinning with thread in her mouth (Vogeikoff-Brogan and Smith, 2010). There are also Mycenaean writings from the second millennium BC, which allude to the participation of children in linen work, carding, spinning, sewing, and weaving (Lancy, 2018). There are other sources that attest to the participation of children in this work in ancient times, such as iconographic representations in Egyptian and Greek tombs depicting young artisans working with thread in their mouths (Crowfoot, 1931; Vogeikoff-Brogan and Smith, 2010).

The biological profile of the individuals under study also yields interesting conclusions. Seven of the individuals with this type of wear are female and only one is male, although as mentioned, in this case the maxilla cannot be associated with the postcranial skeleton with any degree of certainty. The youngest documented individual is a juvenile female aged 17–19 years, which suggests that non-adults were incorporated into this work during adolescence. Only two individuals, both women, come from the first level of funerary use, while the remaining six are from the most recent phase. If we cross-reference the CMOL $^{87}Sr/^{86}Sr$isotope analysis data (Merner, 2017) with our results, it is striking that three of the non-local women exhibit traces of extramasticatory wear in their dentition –S9, S11 and S41– and all of them were buried during the second or more recent phase of funerary use. This implies that after the age of 8, when the premolar crown is fully mineralized, these three individuals migrated from their childhood home in southwestern Iberia (Ossa-Morena zone) to the Camino del Molino area (Merner, 2017). This highlights the inclusion of foreign women in the community's craftsmanship during the most recent phase of use.

The association of female individuals with this type of wear with craft work is well-documented in the osteoarchaeological and ethnographic record and in written sources (Barber, 1996; Minturn, 1996). In the Argaric collection from Granada, thirteen women exhibit this pattern, all of them adults except for one juvenile, from different archaeological sites in Granada (Rubio, 2021). In other prehistoric collections, similar grooves are also identified in a majority of women (Lorkiewicz, 2011; Sperduti et al., 2018; Fidalgo et al., 2020). In the Lengyel culture, women use their teeth for spinning and men for leather working (Lorkiewicz, 2010). Similarly, in the medieval Anatolian series, only women show this type of wear (Erdal, 2008). Historical sources suggest that in Modern times, girls were the ones who could spin flax and comb wool, as in present-day populations such as the Akwete Igbo (Nigeria) or Nahya and Kirdasseh (Egypt), where weaving is the domain of women (Crowfoot, 1931; Lancy, 2018). In northern Sudan, children learn to spin at the age of 5–6 years old, although spinning later becomes the domain of women (Crowfoot, 1931).

Ethnographic studies also provide information on the function of the teeth when working with thread (Crowfoot, 1931; Barrett and Gifford,

1933; Wheat, 1967; Erdal, 2008). Thus, we know that traditional spinners used their teeth to moisten the threads (passing them through the incisors in a mesiodistal direction) to collect the knots, to join the two ends of the broken threads, to cut the thread, and to make the rope, twisting the thread with their hands while the incisors functioned as tweezers. Once the grooves were produced by the repetitive action of the activity, they would serve as a guide to maintain the uniformity of the fibres (Cybulski, 1974).

The data presented here seem to point to a possible specialisation of certain people, especially women, in craft work such as spinning, or perhaps a potential division of labour by sex. However, we must be cautious in this consideration given that the sample analysed represents a small proportion of the population buried at CMOL and, moreover, is made up of a greater number of women.

The results obtained are also reinforced by other indicators of sexual differences in CMOL, such as different activity patterns visible through paleopathological and from diaphyseal and robustness indices (Díaz-Navarro, 2023). The study of the structural indices of the upper extremities of the sample of articulated skeletons suggests the presence of more flattened diaphyses in females without differences in side points is associated with engagement in bimanual activities with repetitive movements that cause unidirectional tension in both arms, while males show more rounded diaphyses that correspond to their engagement in varied movements with multidirectional tension. In contrast, the analysis of the lower limb points to the frequent adoption of squatting and kneeling postures by women and demanding locomotion over rough terrain by men. Similarly, the analysis of pathological processes, such as degenerative joint disease or osteochondritis dissecans, indicates differences in the skeletal parts injured by sex: females exhibit these processes in the upper limbs and males mainly in the lower half of the skeleton (Díaz-Navarro, 2023). Strontium isotopic analysis also supports this hypothesis (Merner, 2017). The local male population of CMOL showed a higher Sr isotopic variation compared to the local female population, supporting a gendered division of mobility. The Sr isotope results support transhumance as an important economic practice at CMOL and the existence of possible wide-ranging networks between Copper Age communities in the Iberian South. In this regard, it is important to bear in mind the importance of livestock and transhumant activity in the economic model of the populations of this area of the present-day Region of Murcia, whose origins date back to the Iron Age (Ros et al., 2016).

All in all, the results presented here record engagement in a craft activity involving textile production that begins to be practised mainly by women from adolescence onwards and which, although it has its origins in the first level of funerary use, attains greater importance in the most recent phase. However, we must bear in mind the preliminary nature of these conclusions, since in order to determine whether this is an activity carried out mainly by women and, therefore, to hypothesise a possible specialisation of certain women or a potential sexual division of labour in this community, the dental pieces of the isolated skulls must be analysed. This will also allow us to approach the organisation and social complexity of this population and delve deeper into this practice, to glean more insight into the people involved, and determine the age at which they started engaging in this activity, as well as to establish chronologically how long this activity was carried out. Further data are also needed to allow us to distinguish among plant-oriented activities related to food acquisition or storage (*e.g.*, rope, basket and net processing) or domestic handicraft (like mats or clothing manufacture), whose implications may signal a different specialisation.

5. Concluding remarks

The study of tooth wear is shown here to be an excellent tool for identifying the development of specific activities and thus, to delve deeper into the social organisation and complexity of past populations. The eight cases of extra-masticatory wear analysed here show occlusal and interproximal grooves, as well as notching and chipping of the enamel in their palatal anterior dentition. This provides strong evidence of the use of the dentition as a third hand in the production of handmade threads during the Copper Age. The biological profile of the individuals points to a possible specialisation of the Camino del Molino community's women in this economic activity from adolescence. The osteoarchaeological and isotopic data show the development of this labour from the first burial phase and its generalisation throughout the second phase, including non-local women. Future studies focusing on the isolated skulls in the collection will allow us to study in depth the type of raw materials used, the specific production, the people involved in this practice and the age at which they began to carry out this work.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgments

The contribution of Sonia Díaz-Navarro in this study was supported by a Predoctoral Fellowship awarded by the Castilla & León Regional Government and European Social Fund (ORDEN EDU/574/2018). The photographs of this article were taken with equipment financed by the Spanish Universidad Nacional de Educación a Distancia (UNED 2020 Research Promotion Plans I and II). The authors would like to thank the reviewers for their comments, which were very useful for the final drafting of the manuscript. Finally, we would like to thank Dr. Joaquín Lomba, director of the Camino del Molino excavations for providing the archaeological information.

Sources of funding

Predoctoral Fellowship - Castilla & León Regional Government and European Social Fund (ORDEN EDU/574/2018).

Author contributions

SDN contributed to the study conception and design. Material preparation and data collection were performed by SDN and MHU. The development of high-resolution replicas and their microscopic study has been carried out by RGG, NC and SDN. The first draft of the manuscript was written by SDN and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Legal and ethical implications

The human remains studied in this work come from archaeological excavation carried out in Camino del Molino (Caravaca de la Cruz, Murcia, Spain) and date back to c. 4500 years ago. The sample analysed is legally deposited in the Archaeology Laboratory of the University of Murcia, where it will remain until the conclusion of the anthropological study authorised for the development of the Doctoral Thesis of SDN. All ethical and legal regulations have been followed in this work, given that high-resolution replicas of the dental pieces have been made to avoid destructive analysis and the unnecessary removal of human bones.

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