

Supernumerary Teeth from Two Mesoamerican Archaeological Contexts

William N. Duncan*

Department of Anthropology, St. John Fisher College, Rochester, NY

ABSTRACT: Supernumerary teeth are uncommon but have been well documented clinically. The majority of cases are isolated anterior teeth; examples of multiple or posterior supernumerary teeth are less common. This paper describes two examples of supernumerary teeth from archaeological contexts in Mesoamerica. The first case is of three individuals with supernumerary posterior teeth found in skull rows and pairs in a Postclassic Maya temple at the site of Ixlú in northern

Case studies of supernumerary teeth have been recorded clinically at least since the Paul of Aegina discussed their treatment in the 7th century among the Greeks, the 10th century in Persia, and the 18th century in France and Germany (Guerini, 1909). Although a rare trait, constituting a deviation in normal dental development, case studies of isolated supernumerary teeth are not uncommon in the clinical literature from around the world (Garvey *et al.*, 1999; Orhan *et al.*, 2006; Rajab and Hamdan, 2002; Scheiner and Sampson, 1997; Solares and Romero, 2004; see Yusof, 1990; Zhu *et al.*, 1996 for review articles). Case studies have also been reported in archaeological (Alt, 1990) and paleontological contexts reaching back to earlier hominids (Ripamonti *et al.*, 1999). Finding examples of nonsyndromic multiple supernumerary teeth is rarer however. In this paper I review what is known about frequency, nosology, location, ontogeny, function, and mode of inheritance of supernumerary teeth and describe cases from two archaeological contexts in Mesoamerica. The first context is a Postclassic Maya temple at the site of Ixlú in northern Guatemala in which there were 21 skulls arranged in rows and pairs. Three of these individuals had supernumerary mandibular teeth and 2 individuals exhibited them bilaterally. The second context is from Oaxaca, Mexico. An individual had one supernumerary tooth that was unerupted but visible due to broken mandible. I conclude the paper by discussing the cases' relevance to biological distance analyses.

BACKGROUND

Supernumerary teeth are typically classified with reference to number of teeth, morphology (Kalra *et al.*, 2005), and location. The number of teeth is clinically meaningful because multiple supernumerary teeth are

Guatemala. Two of these individuals exhibited bilateral supernumerary mandibular teeth. The second context is a Zapotec burial from the Jalieza site in Oaxaca, Mexico. This individual exhibited a single supernumerary tooth. The paper reviews supernumerary teeth with regard to frequency, ontogeny, and mode of inheritance and discusses the cases' relevance for biological distance analyses. *Dental Anthropology* 2009;22(2):39-46.

typically syndromic (Fernández Montenegro *et al.*, 2006; Garvey *et al.*, 1999) and because increased numbers of teeth are more likely to require intervention (Högström and Andersson, 1987). Fernández Montenegro *et al.* (2006) classify morphology as eumorphic (retaining the normal features of a member of the tooth field in which they develop) and heteromorphic. They divide heteromorphic teeth into conical, tuberculate, molariform, and infundibular. Garvey *et al.* (1999) divide morphology into conical, tuberculate (having multiple cusps, which includes invaginated or barrel shaped teeth), supplemental (eumorphic), and odontome (further classified as either complex or compound). The last category, odontomes, is not universally agreed upon as a supernumerary tooth class (De Oliveira Gomes, 2008; Garvey *et al.*, 1999). In addition to normal tooth fields, location is frequently categorized as mesiodens, distomolars, or paramolars (Fernández Montenegro, 2006). However, some teeth that are inverted can also be classified as nasal (Alt, 1990; Hiranandani and Melgiri, 1968).

Assessments of population percentages exhibiting supernumerary are fairly consistent in the literature and range from 0.1-3.6% when including all teeth (Brook, 1974; Liu, 1995; Hopcraft, 1998; Scheiner and Sampson, 1997; see Luten, 1967 for review of earlier studies). Separating permanent and deciduous teeth suggests that the phenomenon is more common in the former (0.5-3.8%) than the latter (0.3-0.6%; Fernández

*Correspondence to: William N. Duncan, Department of Anthropology, St. John Fisher College, 3690 East Avenue, Rochester, NY 14620
E-mail: bduncan@sjfc.edu

Montenegro *et al.*, 2006; Scheiner and Sampson, 1997). The majority of these cases are single teeth (77-86%; Orhan *et al.*, 2006; Scheiner and Sampson, 1997; Rajab and Hamdan, 2002). Cases of multiple supernumerary teeth are less common and most often associated with syndromes, such as Gardner syndrome, or cleft lip and palate, or cleidocranial dysplasia. Orhan and colleagues (2006) note that over 20 conditions have been associated with supernumerary teeth.

Nonsyndromic cases of supernumerary teeth (hyperdontia) have been reported occasionally in the literature as well, though they are rarer (Bayar *et al.*, 2008; Desai and Shah, 2007; Gündüz and Muğlali, 2007; Kalra *et al.*, 2005; King, 1993; Leite *et al.*, 2007; Leslie, 1984; Moore *et al.*, 2002; Manrique Morá *et al.*, 2004; Mopager *et al.* 2002; Rosenthaler and Beideman, 1983; Ruhlman and Neely, 1964; Orhan *et al.*, 2006; Refoua and Arshad, 2006; Sasaki *et al.*, 2007; Sharma, 2001; Yusof and Awang, 1990; Yusof, 1990; Zhu *et al.*, 1996; see references therein for earlier case studies and Açıkgöz *et al.*, 2006 in particular for review). It should be noted that some researchers quantify supernumerary teeth as single teeth, doubles, or multiples, but count the latter category as having more than 5 extra teeth (*e.g.*, Arathi and Ashwini, 2005; Scheiner and Sampson, 1997), although it is unclear if this classification has any etiological basis. The highest number of nonsyndromic supernumerary teeth I have seen in the literature is 22, in a 10-year-old male (Rizzuti and Scotti, 1997). Açıkgöz *et al.* (2006) found a frequency of 0.06% of all cases of supernumerary teeth exhibited multiple teeth in a retrospective study. De Oliveira Gomes *et al.* (2008) found 37% of individuals with supernumerary teeth had more than 1, but only 2% had 5 or more.

Males are more affected by supernumerary teeth than females, and the reverse is true for congenital absence of teeth (Brook, 1974). Rajab and Hamdan (2002) report a male to female ratio of 2.2:1. Similar numbers were found by other studies (Mason *et al.*, 2002; Mitchell, 1989), but higher and lower estimates exist. Davis (1987) found a ratio of 6.5 males to every female in a sample of 1,093 Hong Kong school children (2.74% with a 95% confidence interval of $\pm .9604\%$). Brook (1974) however found a male to female ratio of 1:0.7 among 1,115 white British school children (2.1% with a 95% confidence interval of $\pm 0.83\%$). Given the overlapping confidence intervals in the estimates, the difference in sex ratio may be due to variation between populations or sampling fluctuation. There is some variability reported regarding the overall frequency of supernumerary teeth among populations. Brown (1990) and Zhu *et al.* (1996) report that Subsaharan African and Asian populations exhibit somewhat higher prevalence (between 2.7% and 3.4%) than that found in Brook (1974) and Luten (1967). That said, the relative population frequencies among the different categories and locations of supernumerary

teeth are still unknown, so accurately characterizing interpopulation variability remains difficult.

Some studies report the most common supernumerary teeth are mesiodens (see Garvey *et al.*, 1999; Refoua and Arshad, 2006), which may reflect a high representation of European data in the literature because variation exists. Luten (1967) found the most common locations (in decreasing order) to be upper lateral incisors, mesiodens, upper central incisors, and premolars when both permanent and deciduous dentitions were combined. Orhan *et al.* (2006:891-892) note that the most common supernumerary teeth are mesiodens, followed in descending frequency by "maxillary fourth molars, maxillary paramolars, mandibular premolars, maxillary lateral incisors, mandibular fourth molars, and maxillary premolars." Also, Fernández Montenegro *et al.* (2006) found lateral incisors and canines to be rare relative to other, distal positions. Thus, while most studies find increased frequency in maxillary and anterior position, there is variability. There does seem to be agreement that when multiple nonsyndromic supernumerary teeth are present, they are most often premolars (Açıkgöz *et al.*, 2006; Solares and Romero, 2004).

As noted, multiple supernumerary teeth frequently are associated with syndromes. The actual mechanism resulting in supernumerary teeth is often attributed to independent, hyperactivity of the dental lamina in a localized context (Solares and Romero, 2004). Another explanation is that after supernumerary teeth could emerge from a dichotomized tooth bud (Brook, 1984; Leite, 2007; Moore *et al.*, 2002; see D'Souza and Klein, 2007 for review). A third, but less cited explanation is an atavistic origin (Hattab *et al.*, 1994; Marya and Kumar, 1998). Development of supernumerary teeth can happen at different times in life. Järvinen (1976) documented a case in which supernumerary teeth were extracted in a child and later X-rays disclosed that more supernumerary teeth had developed. What does seem clear is that although there may be some non-genetic or epigenetic involvement (Suda *et al.*, 2007), there is a genetic component (Batra *et al.*, 2005; Becker *et al.*, 1982; Desai and Shah, 2007; Langowska-Adamczyk and Karmańska, 2001; Marya and Kumar, 1998; Mercuri and O'Neill, 1980; Umweni and Osunbor, 2002) and it does not appear to be the result of simple Mendelian inheritance (Yusof, 1990). Studies have suggested that transmission of supernumerary teeth may be autosomal dominant (Batra *et al.*, 2005) or sex linked (Hattab *et al.*, 1994), the latter scenario might account for the higher frequencies in males.

Case 1 – Ixlú

At the Maya site of Ixlú, in northern Guatemala, 21 skulls were found in pairs and rows in a Postclassic temple (Structure 2023; Fig. 1). The skulls were visually examined and were not radiographed. Three of these

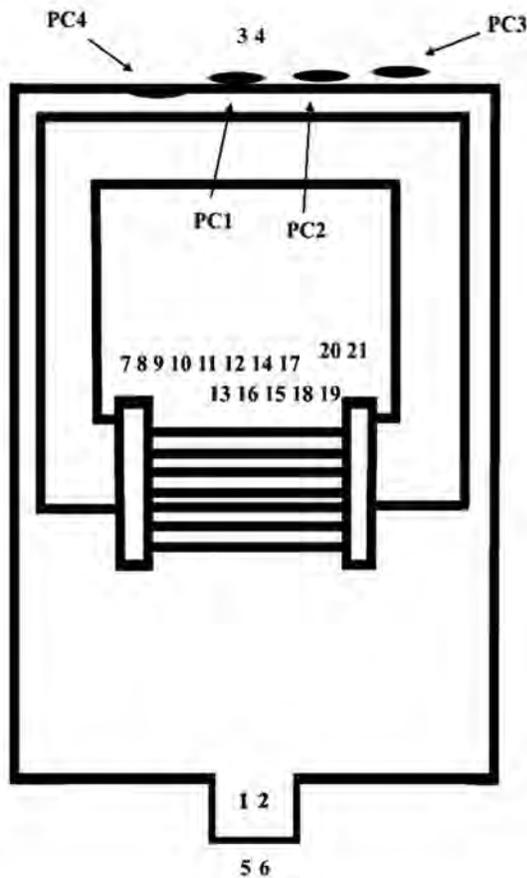


Fig. 1. Position of skulls in pairs and rows at Structure 2023 in Ixlú, Guatemala. Locations are denoted by positions of the numbers, 1 through 21. PC stands for postcranial remains.

individuals exhibited supernumerary teeth (skulls 1, 7, and 16). All of these teeth were erupted with the exception of the left side supernumerary tooth on individual 1 (see below). Six skulls had been placed in pairs on the midline on the east and west sides of the building (skulls 1, 2, 3, 4, 5, and 6) in a late construction stage. Postcranial remains of 4 individuals were placed on top of this floor as well on the west side of the building perpendicular to the skull pairs. The postcrania lacked hand, foot, or cranial elements and exhibited cutmarks at the joints of the long bones. The long bones were placed on top of the axial skeletons in bone bundles (Duncan, 2005). The other skulls were placed in rows above the skull pairs, above a lower floor in the center of the building. It should be noted that there were two episodes of deposition and that skulls 1 and 2 appear to have been interred at the same time as the skull row (Duncan, 2005). Skulls 3, 4, 5, and 6 likely correspond to the four postcrania found behind the temple, though individuation proved impossible. All of the skulls were seated on the floors and faced east except for those clearly

overturned by root action. All skulls except for 2, 10, 11, 15, 18 had articulated cervical vertebrae underneath them. It should be noted that skulls 10 and 11 were only represented by fragments of cortical bone and could not be identified as separate skulls osteologically in laboratory analysis. However, they intersected a looter's trench, and it is parsimonious to include them in the final count of 21. It is likely that other skulls were also part of the rows and were originally located to the south of skull 13 prior to looting (Fig. 1). Sex was assessed by the use of standard anthroposcopic features described in Buikstra and Ubelaker (1994), with the omission of the mastoid process, which may be artificially hypertrophied in this culture area due to tumpline use. Three of the skulls in pairs and 8 of the skulls in rows could be assessed for sex, all of which were male (including skulls 1 and 7). Poor preservation precluded using cranial suture closure to assess age, but all of the skulls that could be observed were either late adolescent to adult in age on the basis of dental eruption. Markers that may have been used to distinguish young versus older adulthood (the sphenoccipital synchondrosis and the palate sutures) were not observable. Two of the skulls (2 and 5) exhibited frontooccipital cranial modification and skull 13 exhibited dental modification (Romero [1970] III-6 Style).

Skull 1, an adult male, exhibited bilateral supernumerary mandibular teeth. On the left side, the tooth was found between P4 and M1 and was lingual to the tooth row (Fig. 2). The tooth was tuberculate with a dominant buccal cusp and a weak lingual cusp. A small accessory mesial cusp was visible as well (Fig. 3). No occlusal wear was visible on the tooth, and it would not have been in contact with maxillary teeth. The alveolar bone was broken around this tooth, but it may not have been emerged in life. There is no evidence that it displaced



Fig. 2. Supernumerary teeth in skull 1, Ixlú, Guatemala. There is an extra premolar lingual to the distal premolar on the specimen's left side. Note that there also is a extra, conical tooth on right side of the jaw.

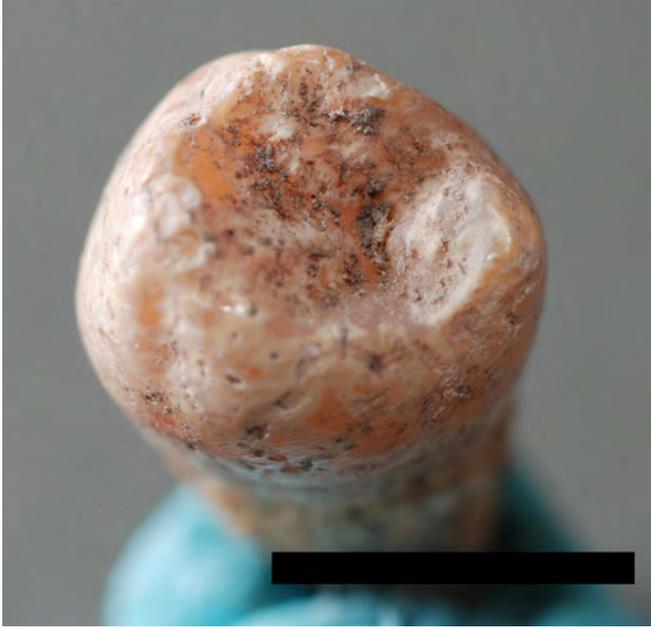


Fig. 3. Supernumerary tooth on left side from skull 1, Ixlú, Guatemala. Occlusal view from the buccal side. Scale 5 mm. Photo courtesy David Long.

other teeth. The root appears to be incisiform, and no radicals were visible. The right side supernumerary tooth was between the canine and P3 and was also lingual to the tooth row (Fig. 2). It was conical with slight lingual invagination and had no occlusal wear. The tooth root was broken near the cemento enamel junction. Poor preservation precluded assessing if the adjacent teeth would have been displaced. There is no evidence that other teeth were altered in size.

Skull 7, an adult of unknown sex, exhibited bilateral supernumerary mandibular teeth. The left supernumerary tooth was lingual to P3, displacing it buccally (Fig. 4). The supernumerary tooth was molariform, exhibiting 5 cusps and had a talonid. It was in occlusion and the roots could not be observed. No wear was present, and it would not have made contact with maxillary teeth unless other teeth had worn down considerably more. The right supernumerary tooth was between P3 and P4, though mesial to the tooth row (Fig. 5). It was tuberculate, exhibiting a single primary cusp and an accessory distal cusp. The tooth was not well preserved and the apex of the root was broken. It was not in occlusion and it is unclear if it would have displaced other teeth. There is no evidence that other teeth were altered in size.

Skull 16, a late adolescent to adult of unknown sex, exhibited a single supernumerary mandibular tooth (Fig. 6). The tooth was mesial to the other premolars and between P3 and P4 on the right side. The tooth was tuberculate with a dominant buccal cusp and 2 lingual cusps of roughly equal size. The buccal side exhibited



Fig. 4. Supernumerary tooth on left side from skull 7, Ixlú, Guatemala.



Fig. 5. Supernumerary tooth on right side from skull 7, Ixlú, Guatemala. Occlusal surface from lingual view. Distal cusp is on the right. Scale 5 mm. Photo courtesy of David Long.



Fig. 6. Supernumerary tooth from skull 16, Ixlú, Guatemala. Scale is 5 mm. Photo courtesy of David Long.

2 grooves on it. The tooth was not in occlusion and no wear was evident. The root was longer buccolingually than mesiodistally and exhibited no radicals. The apex of the root was not closed. Preservation precluded observing whether or not other teeth were displaced because of the supernumerary tooth, though it is likely that it did given its size and location. The third molars were bilaterally somewhat smaller than the other teeth, though it is unclear if this stems from the supernumerary tooth.



Fig. 7. Supernumerary tooth from individual at Jalieza, Oaxaca, Mexico. This tooth (unerupted) is visible in the alveolus because it has resorbed the buccal aspect of the bone adjacent to it. Its position is between the roots of the two erupted premolars. Scale 5 mm.

Case 2 - Jalieza

The second context that yielded a supernumerary tooth was a Late Classic period burial from the Zapotec site of Jalieza in the Oaxaca valley. The individual was an adult male. The supernumerary tooth was unerupted and was only visible because the surrounding alveolar bone was broken. The dentition was visually assessed and was not confirmed with an X-ray. The tooth was visible on the left buccal side of the mandible and was between P3 and P4 (Fig. 7). It was superior and mesial to the mental foramen. Neither the crown nor root morphology was visible. There was no evidence of displacement of any of the teeth but the third molar on the left side was absent (Fig. 8).

DISCUSSION

The Ixlú case stands out primarily because of the likelihood of finding three individuals in such a small sample with supernumerary teeth is so low. There have been no studies on the frequency of supernumerary teeth in Mesoamerican populations, but two Maya biodistance studies have found them. Jacobi (2000) found 3 cases of supernumerary teeth at Tipu out of over 500 burials. Two were single teeth and 1 individual had 2 supernumerary teeth. All were maxillary. Lang (1990) found a total of 13 supernumerary teeth in her study at Lamanai out of 89 individuals. Six of these were maxillary and resemble Jacobi's description. However, 7 were mandibular and resemble what I found at Ixlú, based on Lang's (1990) description. In a clinical context Hopcraft (1998) found that 1.6 to 3.1% of people have supernumerary teeth but only 3 to



Fig. 8. Absence of left mandibular third molar from individual at Jalieza, Oaxaca, Mexico. Scale 5 mm.

10.9% of supernumerary teeth are in the premolar field, a range consistent with aforementioned citations. If one accepts the interval of 1.6 to 3.1% as the range of frequencies for some manifestation of supernumerary teeth (and there is no current evidence to think it is more common among the Maya than that) the average is 2.35%, and the average of 3% and 10.9% is 6.95%. 6.95% of 2.35% is 0.16% or a 1 in 625 chance of having this trait. I used the resampling software (and modified the "birthday program"; Simon, 1990) to estimate the likelihood of finding 3 of 17 individuals having mandibular supernumerary teeth with this frequency. Only 17 individuals were observable for the trait. If the likelihood of finding mandibular supernumerary teeth is 1 in 625, then one can randomly select 17 numbers from 625. This was repeated 10,000 times, out of which 17 times or 0.2% that the same number came up 3 times, which is statistically significant and suggests that the individuals were likely related, although at what level remains unclear.

The two cases described here also highlight three potential problems with using supernumerary traits in biodistance analyses. The first problem, highlighted by the Jalieza case, is that many supernumerary teeth are subclinical in life and invisible in death because they do not emerge so including them in such analyses may actually obscure relationships. This is consistent with Açıkgöz *et al.* (2006) who found 30 of 37 supernumerary teeth they studied to be impacted. Certainly such traits have utility, but are other people in the skull rows and pairs who have supernumerary traits just not being counted? The second problem, also highlighted by the Jalieza case, is that there may be interactions between tooth fields. The congenital absence of the third molar on the same side may or may not be due to the supernumerary tooth, but accounting for the correlation if you are using both as separate traits is necessary. This may mimic examples in which supernumerary teeth were found in conjunction with atypical morphodifferentiation (Manrique Morá *et al.*, 2004). Finally, the Ixlú cases suggest that supernumerary teeth likely should be scored as present or absent in biodistance analyses. The fact that the left supernumerary tooth is highly molariform and the right is much simpler in skull 7 at Ixlú may suggest that influences reflect environmental influence. Similar heterogeneity has been found in individuals with many more supernumerary teeth as well (So, 1990). This could be true whether they are attributable to the splitting of the tooth bud or localized or independent activity of the lamina.

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