

The Eruption Patterns of the Teeth of Nigerian Local Pigs (*Sus scrofa*): Profile of Deciduous Teeth

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Abstract

The pigs, domesticated about 6000 years ago, are highly prolific omnivores belonging to the Family Suidae and Order artiodactyla along with their other hooved counterparts. They qualify as models for various translational research studies (including dental studies) because of their anatomical and physiological similarities to humans. There is however a dearth of information as regards the deciduous dental eruption profile (sequence and timing of eruption) of the Nigerian local pigs (NLP). This study was designed to determine the deciduous eruption profile in the NLP to assist in the management of the breed and in a bid to making the NLP more obvious as suitable animal models in dental research. A total of 51 healthy piglets (from postnatal day 1) were used for this. Their oral cavities were examined every other day for 29 weeks for signs of dental eruption. Looking at Mandibular (Md)

and Maxillary (Mx) eruptions for Incisors (I), Canines (C), Premolars (P) and Molars (M). The modular sequence in the NIP was Md/ Mx I3 (at birth), C (at birth) →Md I₁→Md P₃→MxP³ →MxI¹ → Md I₂ →MdP₄ →MxP⁴ →MxP²→ Md I₂→MxI². It was also observed that variations in eruption timing exist amongst individuals and sexes while variation in eruption sequence exists between NLP and various breeds of pigs based on the literature. The results of this study will be particularly important to farmers, and researchers into NLP especially those using pigs in Nigeria as a model for translation research.

Keywords: Deciduous teeth; Dental Eruption; Local Pigs; Nigeria

Introduction

The pig belongs to the Suidae family (Clutton-Brock, 1999) and the order Artiodactyla, along with cattle, sheep,

goats, camels, deer, giraffes, and hipopotamuses (Huffman, 2006), with a worldwide distribution of about 500 species (Rothschild, 2004). It displays enormous phenotypic diversity in terms of shape, colour, size, production and reproduction abilities (Osei-Amponsah *et al*, 2017; Wiener and Wilkinson, 2011; Wilkinson *et al*, 2013). Due to their anatomical and physiological similarities with humans, and the availability of disease models, pigs have been used as models in some biomedical and pharmacological studies (Larsen and Rolin 2004; Stembirek *et al*, 2012; Tudor *et al*, 2010; Van der Laan *et al*, 2010; Wang *et al*, 2007). The pig's oral mucosa has been used to study the process of scar-free wound healing and drug permeability (Campisi *et al*, 2008; Larjava *et al*, 2011; Mak *et al*, 2009). Pig models have also been used to study regenerative processes following periodontal stem cell application (Sonoyama *et al*, 2006), dental implantations (Nkenke *et al*, 2005), bone renewal research (Sun *et al*, 2010) and regeneration of teeth and jaw bones (Ding *et al*, 2010; Xu *et al*, 2012; Zheng *et al*, 2009).

The Nigerian local pigs (NLP) or the West African Dwarf pigs, are characterized by small body sizes with short foreheads, straight tails, elongated snouts and medium-sized, semi-erect ears. They have narrow body conformation with relatively long legs and

slightly inclined rumps. They have predominantly black colour coats, with others being brown, white and black or patchy and spotted (Adeola *et al*, 2013; AU-IBAR 2015; Osei-Amponsah *et al*, 2017). NLPs are well adapted to local conditions and are commonly resistant to a variety of endemic parasitic and infectious diseases (Abenga and Lawal, 2005; Penrith *et al*, 2004).

Teeth are hard, whitish structures in the mouth of vertebrates, used for breaking down food. They are made up of tissues of varying density and hardness, such as enamel, dentine, and cementum (Romer and Parsons, 1977). These structures surround a pulp cavity which consists of neurovascular bundles (Warwick and Williams, 1973).

Mammalian dentition refers to the types (incisor, canine, premolar, and molar), shapes, number, and arrangement of teeth in the mouth of a given species, at a particular age (Angus, 2007). All pigs are diphyodonts with heterodont dentition. (Stembirek *et al*, 2012). The deciduous dentition of the domestic pig is made up of 28 teeth ($2 \times \text{incisors}^{3/3}$, $\text{canine}^{1/1}$, $\text{premolars}^{3/3}$, $\text{molars}^{0/0}$), with the maxillary and mandibular third incisors and canines, being present at birth, as the needle teeth (Swindle, 2010). The deciduous teeth are thereafter replaced by a permanent set totaling 44 ($2 \times \text{I}^{3/3}$, $\text{C}^{1/1}$, $\text{P}^4 \text{I}_4$, $\text{M}^{3/3}$) (Tucker and Widowski, 2009).

The eruption pattern of the deciduous teeth of several breeds of pigs have been reported, including European wild pigs (*Sus scrofa*) (Matschke, 1967), Yorkshire pigs (Tucker and Widowski, 2009), Large White pigs (Tonge and McCance, 1973) and Miniature breeds of pigs (Gier, 1986; Swindle, 2010; Wang *et al*, 2007; Weaver *et al*, 1969). However, no information appears to be available on the dental eruption pattern of the deciduous teeth of the NLP. The aim of this work, therefore, was to study the pattern of eruption of the deciduous teeth of Nigerian local pigs (*Sus scrofa*), in a continuing effort to provide baseline information on this breed of pigs, in Nigeria

Material and Methods

Animals and farm selection

Five (5) NLPs (One male and four females, aged between 18 to 24 months) were obtained from Gbogan, Ibarapa North West Local Government and Iseyin Local Government, Oyo state for this study. They were housed and adequately fed, with a combination of concentrate and brewery waste, in concrete pens at the piggery unit of the Teaching and Research farm, University of Ibadan. Water was also provided, *ad libitum*. All the sows were mated naturally, and the fifty-one (51) healthy piglets produced were used for this study.

Methods

Observations were made thrice in a week, from birth until the eruption of the last deciduous tooth. Piglets were firmly held in dorsal or lateral recumbency and the mouth of the piglets were gently held open to visually examine all quadrants of the dental arches (right and left maxillary, right and left mandibular). Tooth eruption was considered to have occurred with the gingival penetration and emergence of any portion of the crown (Suri *et al*, 2003; Tucker and Widowski, 2009).

The experiment and procedures employed were ethically reviewed and approved by the University of Ibadan-Animal Care and Use in Research Ethics Committee (UI-ACUREC).

Statistical analysis

GraphPad Prism 5[®] was used for statistical analysis and data expressed as Mean±S.E. Sequence of dental eruption was determined by calculating the mean values of eruption time of each tooth across all piglets and ordering the mean values in an increasing order.

Results

The mean values and range of deciduous eruptions are as stated in Table 1 and pictorial evidence of erupted teeth are seen in Figures 1-9.

Female piglets (gilts) had lower mean values for eruption time, in comparison

to the males (barrows). Results obtained showed that 50% (n=5) of the teeth examined erupted earlier in the gilts when compared with the barrows. Similarly, the gilts completed their eruption in 60% (n=6) of the teeth, ahead of the barrows. Only 10% (n=1) of the teeth eruption was completed in the barrows, ahead of the gilts. These observations were, however, not statistically significant.

The sequence of eruption, as stated under table 1, showed a progression from one tooth to another, based on the mean eruption time for each tooth. However, slight variations were observed in some individual piglets. Result obtained showed that 20% (n=10) of the piglets erupted the first maxillary incisor (MxI¹) before maxillary premolar 3 (Mx P³), while 22% (n=11) of the piglets, erupted the fourth mandibular fourth premolar (Md P⁴) before the second mandibular premolar (Md P²).

Staining of the needle teeth, from deep yellow to dark brown, was observed in some piglets, from every litter.

Bilateral polydenty of the third maxillary incisors (Fig 9) was observed in two gilts while it was observed as a left unilateral occurrence in a barrow. These supernumerary teeth were located between the maxillary canine and the third incisor teeth in all affected piglets.

Discussion

The overall chronology of deciduous dental eruptions for NLPs was observed to be different from those observed in European wild pigs (*Sus scrofa*) (Matschke, 1967), Yorkshire pigs (Tucker and Widowski, 2009), Large white pigs (Tonge and McCance, 1973) and miniature breeds of pigs (Gier, 1986; Swindle, 2010; Wang *et al*, 2007; Weaver *et al*, 1969). A comparison of the chronology of mandibular and maxillary eruptions for deciduous teeth in different breeds of pig is shown in Table 2.

The observed difference in the timing of the eruptions may be due to genetic or environmental factors associated with the NLPs. Tucker and Widowski (2009), reported that husbandry practices and breed selection activities could have an influence on the onset of dental eruption.

Although the mean values showed no statistical differences in the eruption timing of individual tooth, the gilts had advanced eruptions for the first mandibular and maxillary incisors, the second mandibular incisor, and the mandibular and maxillary third premolar teeth, ahead of the barrows. This observation is similar to the findings of Tucker and Widowski (2009), who reported that Yorkshire gilts had early eruptions ahead of the barrows. This observation was however different from the findings reported in miniature

pigs, where there was no sexual difference in dental eruption (McKean *et al*, 1971; Weaver *et al*, 1969). Of the several factors thought to be responsible for delayed teeth eruption (Suri *et al*, 2003), systemic stress is considered to be the primary cause of teeth eruption delays in animals (Tucker and Widowski, 2009).

While Herring and Wineski (1986), showed that a relationship exists between dental development, specifically the premolars, and chewing behaviour in miniature breeds of pigs, Tucker and Widowski (2009) showed that premolar eruption had a direct relationship with the amount of time piglets spent at the creep feeder, post weaning. Therefore, early dental development in the gilts could result in increased feed intake before and after weaning. Delumeau and Meunier-Salaün (1995), suggested that gilts may have greater abilities to adapt to learning novel behaviours, including feeding, when compared with barrows.

Deciduous teeth staining in post-natal life could be intrinsic or extrinsic in origin. The fact that some piglets in this study were observed to have discoloured needle teeth a few days after birth could be due to some conditions in-utero. Intrinsic staining of dental tissues usually occurs during pre-natal tooth development and several factors including several metabolic disorders,

excess fluoride intake, tetracycline administration, vitamin D deficiency, or any disturbance affecting the normal development of dentine or enamel have been implicated (Tucker and Widowski, 2009). Staining of teeth has been noted in the Sinclair miniature breed of pig, although age and time of onset was not provided (Gier, 1986).

Supernumerary teeth or polydonty is thought to be of congenital origin and may result from development of excess dental lamina, an additional follicle, or an extension of the dental lamina after the deciduous, as well as the permanent follicles which may result in the formation of additional tooth germs (Lin *et al*, 2009, Malmsten *et al*, 2015). They can be found in any part of the dental arch in the oral cavity. Although the condition is thought to be uncommon in pigs, it has however been reported in wild boars (Malmsten *et al*, 2015). Congenital disorders such as polydonty may result in excessive wear of the teeth and predispose affected animals to dental diseases including caries and periodontitis (Malmsten *et al*, 2015). This may be due to reduction in interdental spaces and mechanical abrasion of fibres on the supporting gingivae.

The Nigerian local piglets in this study showed a different sequence of eruption, when compared to the Yorkshire

piglets. In the piglets used in this study, the third mandibular premolar erupted before its maxillary counterpart, similar to what Weaver et al., (1969), reported in the Pitman-Moore strain of miniature pigs but the reverse was the case in the Yorkshire piglets. Similarly, the fourth mandibular premolar erupted immediately before its maxillary counterpart, in the Nigerian local pigs but in the Yorkshire piglets, eruption of the fourth maxillary premolar tooth occurred after the eruption of the third mandibular premolar and first maxillary incisor teeth (Tucker and Widowski, 2009). A variation was also observed in the eruption of the first maxillary incisor teeth between our local piglets and the Pitman-Moore strain of miniature swine. While the first maxillary incisors erupted after the third premolars in the Nigeria local pigs, similar to the result obtained in the Yorkshire piglets, those of the miniature pigs erupted before the premolars (Tucker and Widowski, 2009). Eruption sequence within species is thought to be an adaptive feature, hence changes in such sequence could be an indication of how breeds of such species have adapted to their environments over time (Smith, 1994).

Conclusion

This is the first study to examine the pattern of deciduous tooth eruption in the Nigerian local pigs over a period of time. These results clearly indicate that considerable variation in eruption times exists among individuals and litters and in comparison, to other breeds of pigs. In addition, observable differences in the timing of premolar

eruption were found between the current study and earlier studies. This will be particularly important to researchers who will be using pigs in Nigeria as a model for translation research.

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Competing interests

The authors declare that they have no competing interests.

Authors' contributions

M.E. and A.D. raised the animals and monitored the eruption pattern daily and weekly. F.A. was involved in data interpretation. O.J.O. was involved in research design. All authors were involved in data analysis, manuscript reading and correction.

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Table (1): Mean ± Standard Error of the Age of deciduous tooth eruption in the maxilla and mandible for male and female piglets of the Nigerian Local pigs (n= 51)

Tooth Eruption	MALES (n=24)		FEMALES (n=27)	
	Mean ± S.E	Range	Mean ± S.E	Range
Md I ₁ (Days)	12.95±0.73	8–18	12.54±0.74	7–23
Mx I ¹ (Weeks)	3.75±0.15	3–5	3.28±0.22	2–5
Md I ₂ (Weeks)	11.08±0.40	6–14	10.67±0.39	5–13
Mx I ² (Weeks)	17.91±0.58	12–24	16.91±0.53	12–20
Md P ₂ (Weeks)	5.73±0.71	3–13	5.59±0.68	3–13
Mx P ² (Weeks)	7.65±0.20	6–9	7.33±0.16	6–9
Md P ₃ (Weeks)	3.63±0.23	2–6	3.26±0.22	1–5
Mx P ³ (Weeks)	3.38±0.25	2–7	3.19±0.24	1–6
Md P ₄ (Weeks)	6.25±0.17	4–8	6.15±0.17	4–7
Mx P ⁴ (Weeks)	6.33±0.17	5–9	6.00±0.19	5–8

The deciduous eruption sequence elucidated is as follows: **Md/ MxI₃** (at birth), **C** (at birth) → **Md I₁** → **Md P₃** → **MxP³** → **MxI¹** → **Md P₂** → **MdP₄** → **MxP⁴** → **MxP²** → **Md I₂** → **MxI²**

*Note: Md: Mandibular, Mx: Maxillary.

Md I₁, I₂, I₃: Mandibular Incisors 1, 2, 3

Mx I¹, I², I³: Maxillary Incisors 1, 2, 3

Md P₂, P₃, P₄: Mandibular Premolars 2, 3, 4

Mx P², P³, P⁴: Maxillary Premolars 2, 3, 4

C: Canine teeth.

Maxillary and Mandibular canines and Incisor 3 teeth are present at birth.

Table (2): Comparison of the chronology of mandibular and maxillary eruptions for deciduous teeth in different breeds of pig

Tooth Eruption	Nigerian Local pig	Yorkshire Pig	Sinclair Minipig	Pitman-Moore Mini-pig	European Wild Hog	Chinese Minipig
Md I ₁ (Days)	7-23	2-11	1-28	1-28	11-20	7-21
Mx I ¹ (Weeks)	2-5	1-5	4-10	7-28	7-22	1-3
Md I ₂ (Weeks)	5-14		7-11	7-11	9-13	8-21
Mx I ² (Weeks)	12-24		11-19	8-17	10-17	8-21
Md P ₂ (Weeks)	3-13		6-12	6-12	9-15	4-10
Mx P ² (Weeks)	6-9		7-11	5-9	7-12	4-10
Md P ₃ (Weeks)	1-6	2-6	3-5	3-5	4-5	1-5
Mx P ³ (Weeks)	1-7	1-2	3-11	1-3	2-3	1-5
Md P ₄ (Weeks)	4-7	1-3	1-3	1-3	2-3	
Mx P ⁴ (Weeks)	5-9	2-6	7-11	3-4	6-7	6-8

**Fig (1):** Photograph of the oral cavity with arrows showing the "Needle Teeth (Mandibular and Maxillary)

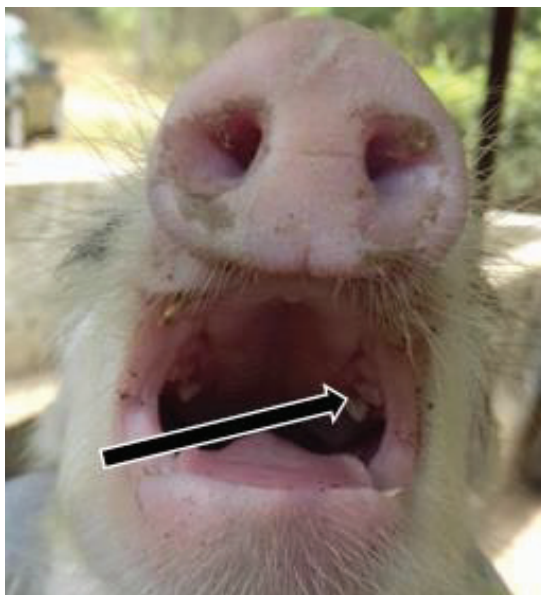


Fig (2): Photograph of the oral cavity with arrow showing erupted Mx p³



Fig (3): Photograph of the oral cavity with arrow showing erupted Md p₂.



Fig (4): Photograph of the oral cavity with arrows showing erupting Mxp⁴ .



Fig (5): Photograph of the oral cavity with arrows showing Mx p² (red arrow), Mx p³ (blue arrow) and Mx p⁴ (black arrow).



Fig (6): Photograph of the oral cavity with arrows showing Mx i³ (thin arrow) and Mx i² (thick arrow).

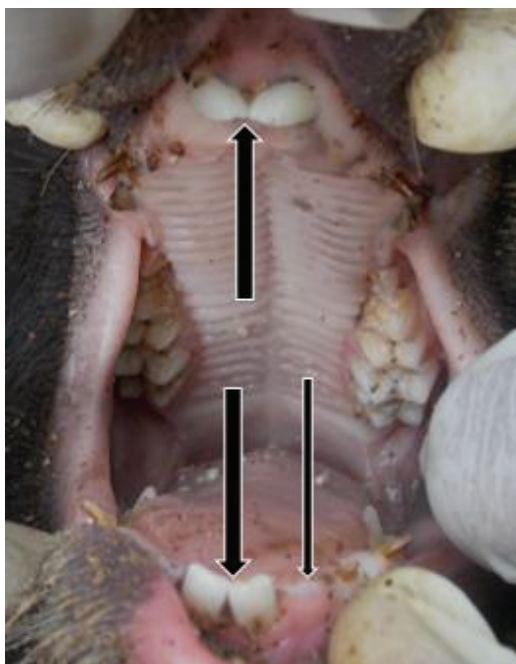


Fig (7) Photograph of the oral cavity with thick arrows show central incisors (Md i₁ and Mx i¹), and Md i₂ (thin arrow)



Fig (8): Photograph of the oral cavity with Left-Right arrow showing stained incisor Mx i³ and canine teeth



Fig (9): Photograph of the oral cavity with arrow showing polydonty of Mx i³

Animal species in this Issue

Pig (*Sus scrofa*)



Kingdom: Animalia & Phylum: Chordata & Class: Mammalia & Order: [Artiodactyla](#) & Family: [Suidae](#) & Subfamily: Suinae & Genus: *Sus* & Species: *Sus scrofa*

A typical pig has a large head with a long snout that is strengthened by a special pre-nasal bone and by a disk of cartilage at the tip. The snout is used to dig into the soil to find food and is a very acute sense organ. Each foot has four hoofed toes, with the two larger central toes bearing most of the weight, and the outer two also being used in soft ground.

Most pigs today are domesticated pigs raised for meat (known as pork). Miniature breeds are commonly kept as pets. Because of their foraging abilities and excellent sense of smell, people in many European countries use them to find truffles. Both wild and feral pigs are commonly hunted.

Apart from meat, pig skin is turned into leather, and their hairs are used to make brushes. The relatively short, stiff, coarse pig hairs are called bristles, and were once so commonly used in paintbrushes that in 1946 the Australian Government launched Operation Pig Bristle. In May 1946, in response to a shortage of pig bristles for paintbrushes to paint houses in the post-World War II construction boom, the Royal Australian Air Force (RAAF) flew in 28 short tons of pig bristles from China, their only commercially available source at the time.

Source: Wikipedia, the free encyclopaedia