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Long-term detrimental effects of tooth clipping or grinding in piglets: a histological approach

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Abstract

The needle teeth of piglets are often cut shortly after birth to prevent damage to littermates and the sow's udder. This practise is, however, contested because the pain it inflicts to piglets may counterbalance its benefits. The purpose of this experiment was to assess the consequences of tooth resection over the subsequent days and weeks by histological examination. Two techniques were compared: tooth clipping with clippers, and tooth grinding with a rotating grindstone. Twenty piglets received each of three treatments (one treatment per half-jaw): clipping, grinding, and control (teeth left intact). Four piglets were slaughtered at each of the following stages: 3, 6, 13, 27 and 48 days after tooth resection. Their teeth were then collected and prepared for histological examination. The analysis revealed that both clipping and grinding induce lesions such as pulp cavity opening, fracture, haemorrhage, infiltration or abscess, and osteodentine formation. Most of these effects appeared sooner and were of greater magnitude after clipping than after grinding. Because most of the observed histological alterations are known to cause severe pain in humans, it is likely that tooth resection — even when achieved through grinding — induces severe pain in piglets. Thus, the rationale of this practice should be re-evaluated.

Keywords: *animal welfare, histology, pain, piglet, tooth clipping, tooth grinding*

Introduction

Piglets are born with eight fully erupted 'needle teeth' (the deciduous canines and the corner incisors) which may be considered "as weapons for neonatal competition among siblings" (Fraser & Thompson 1991). Many pig producers cut these teeth shortly after birth to prevent the damage they may cause to littermates and the sow's udder. This practice is often considered harmless. Indeed, it induces only slight and very short-lived behavioural and physiological changes, as opposed, for instance, to castration (Noonan *et al* 1994; Prunier *et al* 2002). The validity of tooth shortening may be contested, however, because the benefits are not always clear-cut and may be counterbalanced by tooth pain. It is likely that piglets submitted to grinding or clipping suffer from pain, both in the short-term and in the long-term, as pulpitis and gingivitis have been reported after both techniques (Hutter *et al* 1994). The benefits of tooth resection on the occurrence or severity of lesions are controversial. In most studies, there were fewer and/or less severe skin lesions in piglets submitted to tooth resection (Fraser 1975; Brookes & Lean 1993; Hutter *et al* 1994; Brown *et al* 1996; Weary & Fraser 1999). However, in one study, although an advantage was observed at 7 days for clipped litters, at older ages there were more skin lesions in clipped litters (Delbor *et al* 2000). Some authors have observed less damage to the sow's udder after tooth resection (Brookes & Lean 1993; Hutter *et al* 1994), whereas others have observed no difference between intact or tooth-resected litters (Brown *et al* 1996; Delbor *et al* 2000; Bataille *et al* 2002). Conclusions concerning the effects of tooth resection in whole litters on growth rate are also divergent: a higher growth rate (Hutter *et al* 1994), no difference (Fraser 1975; Brookes & Lean 1993; Brown *et al* 1996) and a lower growth rate (Delbor *et al* 2000) have all been observed. When selective tooth resection was carried out within litters, growth rate was lower in clipped than in intact piglets (Robert *et al* 1995; Weary & Fraser 1999; Bataille *et al* 2002). However, this effect was not found in piglets submitted to grinding (Bataille *et al* 2002). The reduction in growth rate after clipping seems to depend on litter size, being more marked in large litters (Fraser & Thompson 1991).

The purpose of the present study was to assess the consequences of tooth resection over the subsequent days and weeks through histological examination of tooth lesions. Two techniques were compared: tooth clipping with clippers, and tooth grinding with a rotating grindstone.

Materials and methods

General

The experiment was performed at the Unité Mixte de Recherche sur le Veau et le Porc (INRA St Gilles, France) and involved 24 crossbred piglets (Large White × Landrace). Conventional management routines were followed including tail docking and iron injection within 48 h after birth and castration of male piglets during the second week of life. Creep feed containing 22% crude protein was provided from 21 days of age. Weaning occurred at day 28.

All experimental piglets received each of the three treatments under study: clipping of two teeth with clippers, grinding of two teeth with an electric rotating grindstone suitably guarded to protect gums (Dremel®, model 395) and control treatment (teeth left intact). Clippers were new and similar to those typically used by pig producers for cutting teeth. Teeth from one half-jaw (one deciduous canine and the lateral incisor) were subjected to the same treatment. The position of the treatments was balanced so that each position (left superior jaw, right superior jaw, left inferior jaw, right inferior jaw) was equally represented for each treatment within each stage of observation (see below). Tooth resection was performed within 48 h after birth by a trained technician with clean materials. The technician was asked to remove about one third of the tooth above the gum line.

Four piglets were slaughtered at each of the five following stages: 3, 6, 13, 27 and 48 days after tooth resection. Four additional pigs should have been slaughtered 180 days after treatment but a clinical examination of their mouths revealed that, at this stage, their lacteal teeth had been replaced by permanent teeth. Immediately after euthanasia (within 3 min), the three experimental samples comprising the two experimental teeth and their surrounding tissues were removed and immediately fixed with 10% formalin at pH 7. Eight teeth were collected per treatment at 3, 6, 13 and 27 days after tooth resection. At 48 days, external signs of tooth resorption were observed in one tooth per piglet per treatment, showing that the process of tooth replacement was strongly engaged. Therefore, we decided to eliminate these teeth and seven teeth were analysed per treatment at this latest stage.

Histological analyses

Histological analyses were performed at the Faculté de Chirurgie Dentaire de Toulouse (France) as previously described for human teeth (Martoja & Martoja-Pierson 1967). Samples fixed in 10% formalin were demineralised in 4% nitric acid, dehydrated in alcohol and embedded in paraffin wax. Serial sections of 5 µm thickness were cut in the axial plane and routinely stained with Masson's trichrome.

Five cuts, spaced 20 µm apart and corresponding to the most central axial part of each tooth (pulp tooth present all along the radicular cavity) were examined with a light microscope at different magnifications. Examination was carried out without knowledge of the treatment group to which each tooth belonged. As previously described for human teeth (Seltzer & Bender 1975), a tooth was considered normal if the pulp contained fibroblast cells embedded in a collagen-rich extracellular matrix, if the vascularisation was normal, and if the bodies of the odontoblasts were located in the periphery (Figure 1, photograph A). Otherwise, the following abnormalities were noted (Schroeder 1987):

Opening of the pulp cavity (Figure 1, photographs B and C). The pulp cavity is open to the external milieu (buccal cavity).

Fracture (Figure 1, photograph B). There is a line of fracture in the dentine structure. When the fracture is complete the pulp cavity is open to the external milieu.

Haemorrhage (Figure 1, photographs B and C). There is an increased blood supply within the pulp. Blood vessels are dilated and signs of extravasation (red cells and plasma) are usually present.

Infiltration (Figure 1, photograph B). Cells, mainly lymphocytes and plasmocytes, are more numerous within the pulp, revealing an inflammatory reaction.

Abscess (Figure 1, photograph D). An aggregation of stained cells is detected, in which polynuclear cells predominate.

Dentine resorption (Figure 1, photograph D). Lacunas (cavities) can be seen within the dentine. They are colonised by polynuclear cells.

Osteodentine (Figure 1, photograph E). A calcified deposit is detected in the pulp cavity. It does not have the tubular structure of the dentine and contains cellular inclusions as in bone or cement.

Necrosis (Figure 1, photograph F). A disappearance (more or less complete) of the cells and fibres from the tooth pulp can be observed.

Statistical analyses

The number of teeth judged as normal or presenting one of the above abnormalities was calculated for each stage and treatment. Comparisons were performed with the 2I test, which is derived from the χ^2 test but is better adapted to small samples and allows the regrouping of experimental treatments (Arbonnier 1966). Three series of analyses were performed: comparison between stages for a given treatment; comparison between treatments for a given stage; and comparison between treatments after regrouping of the stages that did not differ.

Results and discussion

Effect of stage

The analyses revealed a significant effect of stage on the percentages of normal teeth and of teeth with haemorrhage in the control treatment, on the percentages of normal teeth and of teeth with osteodentine and necrosis in the grinding treatment, and on the percentages of teeth with osteodentine in the clipping treatment (Table 1).

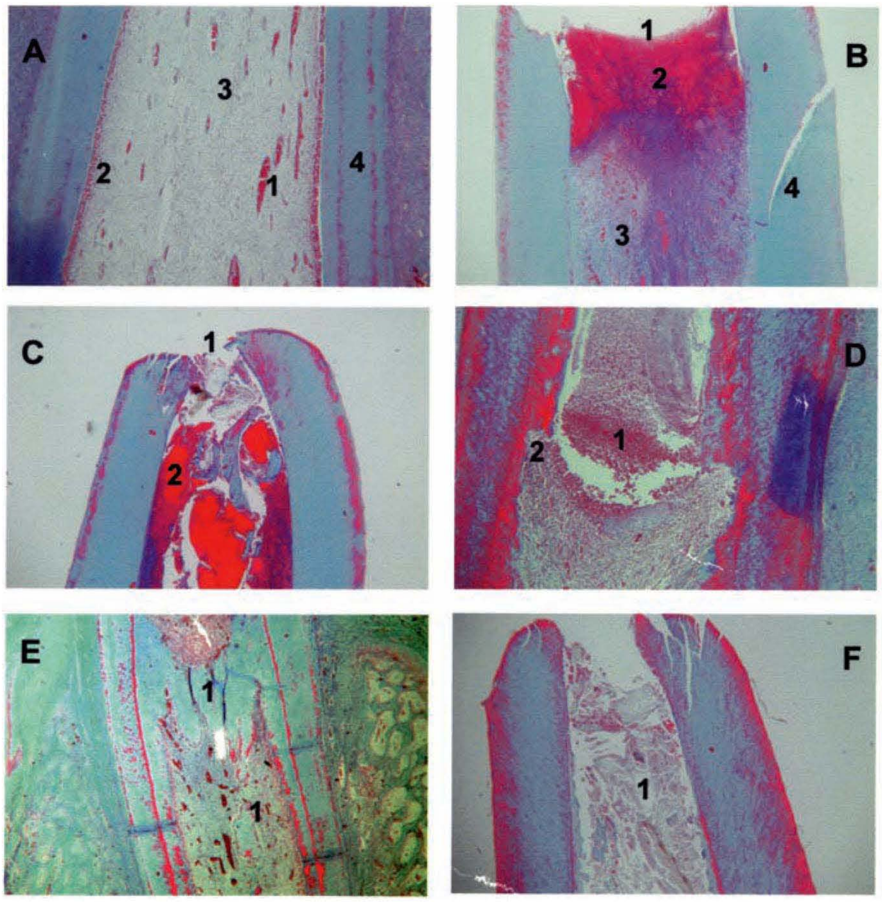

Figure 1 Axial sections of piglet teeth.

(A) Normal intact tooth (× 100) at day 3 after treatment showing rich vascularisation (1) and odontoblasts (2) in the pulp (3); dentine (4) is visible on each side of the pulp. **(B)** Clipped tooth (× 40) at day 3 with opening of the pulp cavity (1), haemorrhage (2), inflammatory cells (3) and a fracture (4). **(C)** Ground tooth (× 40) at day 27 with opening of the pulp cavity (1) and haemorrhage (2). **(D)** Clipped tooth (× 100) at day 28 with an abscess (1) and signs of resorption of the dentine (2). **(E)** Ground tooth (× 25) at day 13 with osteodentine (1). **(F)** Clipped tooth (× 40) at day 48 with signs of necrosis (1).

Among control teeth, the percentage of normal teeth was lower at the latest stage (day 48) than at all other stages ($P < 0.05$). Conversely, the percentage of teeth with haemorrhage was higher at the latest stage than at all other stages ($P < 0.05$). This is indicative of a lacteal tooth resorption process around the fiftieth day of life, as confirmed by buccal examinations performed at that period.

Within the grinding treatment group, the percentage of normal teeth showed an overall decline between 3 and 48 days after treatment ($P < 0.05$). A similar trend was observed in the clipping treatment group between 6 and 48 days.

Osteodentine deposits were observed in clipped and ground teeth only (Table 1). They were first detected 6 days after tooth resection. The percentage of teeth presenting this abnormality was already high at 6 days in the clipped treatment (50%). Among ground teeth, it increased between days 6 and 13 ($P < 0.05$) and remained elevated thereafter. These results are in agreement with those of Hutter *et al* (1994), who also observed dentine proliferation 6 days after tooth resection. As such deposits were never observed in control teeth, they are probably produced in reaction to the lesion induced by resection. They could play a protective role, preventing bacteria from entering the teeth.

Effect of treatment

For most variables, the analysis revealed a significant effect of treatment (Table 1). Only the percentage of teeth with resorption was independent of treatment. A detailed analysis of the results showed that the structural changes appeared sooner in clipped teeth than in ground teeth. Indeed, as early as 3 days after treatment, significant differences were observed between clipped and control teeth in terms of pulp cavity opening, fracture, bleeding, infiltration and abscess formation. At that stage, the only significant difference between ground and control teeth was the percentage with pulp cavity opening. At subsequent stages, the percentage of teeth with pulp cavity opening was increased in both resected treatment groups compared with the control group. However, this percentage was almost always higher after clipping than after grinding (Table 1). Another important difference between the two techniques concerns fractures, which were much more frequent in clipped than in ground teeth regardless of the stage of observation. In the latter group, only one case of fracture was observed. These fractures may be located at the radicular or, more frequently, the coronar level.

When the stages that did not differ were grouped, the analyses showed that pulp cavity opening, bleeding, infiltration by inflammatory cells, abscesses and osteodentine were significantly more frequent in teeth that had been resected than in control teeth (Table 2). The percentage of teeth showing signs of necrosis at 27 and 48 days was higher in ground than in control teeth and was intermediate in clipped teeth. Necrosis is due to cell death and tissue lysis

Table 1 Effect of tooth shortening (control, grinding or clipping) on the number of teeth in each condition at 3, 6, 13, 27 (8 teeth per group) and 48 days after treatment (7 teeth per group).

Treatment	Days after tooth shortening					Stage effect
	3	6	13	27	48	
Normal teeth						
Control	7b	8b	8b	8b	3b	< 0.01
Grinding	6b	4a	1a	3a	0a	< 0.01
Clipping	1a	3a	2a	0a	0a	< 0.1
Treatment effect	< 0.01	< 0.01	< 0.001	< 0.001	< 0.05	
Teeth with opening of pulp cavity						
Control	0a	0a	0a	0a	0a	> 0.1
Grinding	2b	3b	2ab	4b	4b	> 0.1
Clipping	4b	4b	5b	7b	3b	> 0.1
Treatment effect	< 0.05	< 0.05	< 0.01	< 0.001	< 0.05	
Teeth with fracture						
Control	0a	0a	0a	0a	0	> 0.1
Grinding	0a	0a	0a	0a	1	> 0.1
Clipping	4b	4b	3b	3b	1	> 0.1
Treatment effect	< 0.01	< 0.01	< 0.05	< 0.05	> 0.1	
Teeth with haemorrhage						
Control	0a	0a	0a	0a	3a	< 0.05
Grinding	2a	3b	4b	4b	6b	> 0.1
Clipping	6b	4b	5b	5b	5b	> 0.1
Treatment effect	< 0.01	< 0.05	< 0.01	< 0.01	< 0.01	
Teeth with infiltration						
Control	0a	0a	0a	0a	0a	> 0.1
Grinding	1a	4b	5b	4b	5b	> 0.1
Clipping	6b	4b	6b	4b	2ab	> 0.1
Treatment effect	< 0.001	< 0.05	< 0.01	< 0.05	< 0.01	
Teeth with abscess						
Control	0a	0	0	0	0	> 0.1
Grinding	0a	2	2	2	0	> 0.1
Clipping	3b	0	2	2	1	> 0.1
Treatment effect	< 0.05	< 0.1	> 0.1	> 0.1	> 0.1	
Teeth with dentine resorption						
Control	0	0	0	0	1	> 0.1
Grinding	0	0	0	1	1	> 0.1
Clipping	0	2	0	2	1	> 0.1
Treatment effect	> 0.1	> 0.1	> 0.1	> 0.1	> 0.1	
Teeth with osteodentine						
Control	0	0a	0a	0a	0a	> 0.1
Grinding	0	2ab	5b	4b	5b	< 0.01
Clipping	0	4b	6b	5b	4b	< 0.01
Treatment effect	> 0.1	< 0.05	< 0.01	< 0.01	< 0.01	
Teeth with necrosis						
Control	1	0	0	0	1	> 0.1
Grinding	0	0	0	3	4	< 0.01
Clipping	0	0	0	1	2	> 0.1
Treatment effect	> 0.1	> 0.1	> 0.1	< 0.1	> 0.1	

a,b: lack of a common letter within a column indicates that treatments differ at $P < 0.05$

and is the final stage of pulp inflammation. It is likely that the local increase in temperature caused by the action of the grindstone on the teeth promotes this tissue damage.

When comparing the two methods of teeth shortening, a trend was found for a higher percentage of teeth presenting pulp cavity opening and haemorrhage after clipping than after grinding ($P < 0.1$) and a significantly higher percentage for fracture after clipping ($P < 0.05$).

Therefore, tooth resection often leads to opening of the pulp cavity, to pulp inflammation and to abscess formation, whatever the technique used (clipping or grinding). However, these lesions appear sooner and are more frequent with clipping. For instance, clipping generates fractures, which are almost absent after grinding. This is in accordance with the results of Hutter *et al* (1994), who concluded that clipping is more harmful than grinding.

Table 2 Effect of tooth shortening (control, grinding or clipping) on the percentage of teeth in each condition after regrouping of the stages that did not differ.

		Treatment			
	Days after shortening	**Control**	**Grinding**	**Clipping**	***P* value**
Pulp cavity opening[1]	3 to 48 days	0a	38b	59c	< 0.001
Fracture[1]	3 to 48 days	0a	3a	38b	< 0.001
Haemorrhage[2]	3 to 27 days	0a	41b	63c	< 0.001
Infiltration[1]	3 to 48 days	0a	49b	56b	< 0.001
Abscess[1]	3 to 48 days	0a	15b	21b	< 0.01
Resorption[1]	3 to 48 days	3	5	13	> 0.1
Osteodentine[3]	6 to 48 days	0a	52b	61b	< 0.001
Necrosis[4]	27 to 48 days	7a	47b	20ab	< 0.05

[1] 39 teeth per group
[2] 32 teeth per group
[3] 31 teeth per group
[4] 15 teeth per group
a,b: means followed by these letters within a line differ at $P < 0.05$
a,c: means followed by these letters within a line differ at $P < 0.05$
b,c: means followed by these letters within a line differ at $P < 0.1$

Because the organisation and the nerve pathways of the dental tissues are quite similar in mammals, and because the lesions found in the present study are known to be associated with severe pain in humans (Ngassapa 1996), it is likely that tooth resection induces severe pain in piglets. The fact that the teeth that were shortened were lacteal does not allow one to conclude that they were not sensitive. Indeed, in humans, it has been demonstrated that caries and abscesses of lacteal teeth induce pain, particularly upon contact with heat, cold or sugar (Milsom *et al* 2002). The pain inflicted on piglets probably lasts at least up to about the fiftieth day of life, when they lose their lacteal teeth.

It should be noted that for this experiment, special attention was paid to the act of tooth resection: the piglets were caught gently and the amount of tooth reduction was clearly defined (one third to one half of the visible length). This is, of course, not always the case in commercial piggeries, in which clipping up to the gum line is common (Weary & Fraser 1999). Thus, one could expect that the lesions and the pain caused by tooth resection are often of greater magnitude than those in the present study.

It is likely that the opening of the pulp cavity, which is observed in many piglets after tooth resection, constitutes a route for bacterial entry. Indeed, the presence of anaerobic bacteria was detected in clipped teeth (Hutter *et al* 1994). Increased mortality and a higher incidence of arthritis have been associated with tooth clipping in some papers (Burger 1983; Strom 1996) but not in others (Hutter *et al* 1994; Brown *et al* 1996). Conflicting results concerning the effects of tooth clipping on growth rate have been also obtained (Fraser 1975; Brookes & Lean 1993; Hutter *et al* 1994; Brown *et al* 1996; Delbor *et al* 2000). Variation between herds in sanitation levels may explain these differences in the response to tooth clipping.

Animal welfare implications

Shortening of piglet teeth either with clippers or with a rotating grindstone induces major tooth lesions. These lesions are likely to induce pain and to cause health disorders. Therefore, the use of this practice in commercial piggeries needs to be objectively assessed, taking into account the hypothetical advantages (less damage to littermates and the sow's udder) and the drawbacks (pain and health disorders). In cases where the practice of tooth resection is maintained by breeders, it should be carried out with rotating grinders instead of clippers, as lesions are less frequent with this technique.

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