OSTEOCHONDROSIS (OC)/ DYSCHONDROPLASIA IN SLOW GROWING LANDRACE PIGS RAISED UNDER LOW PLANE NUTRITION

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SUMMARY

Osteochondrotic lesions were demonstrated in the Articular-epiphyseal (A-E) cartilage complexes and in the physeal cartilage in Landrace pigs raised in Tanzania. These pigs were slow growing compared to the ones raised in commercial farms in industrial countries, probably due to nutritional factors, they were attaining slaughter weight 70-90kg between 8 to 10 months of age. A radiologic and macroscopic study of osteochondrosis (OC) lesions in the A-E complex and growth plates (physes) was done in 160 Landrace slaughter pigs in Tanzania. The study was of one year period (February 1994 to January 1995). Radiological OC lesions were scored within five grades (1-5) with increasing severity. The elbow, carpus, stifle and tarsal joint bones were scrutinized for OC lesions presence.

It was observed that only a few pigs had gross or radiologic OC lesions. In general 123 (77%) had no radiologic or macroscopic dyschondroplastic lesions. Twenty five (16%) had mild lesions and Twelve (7%) had moderately severe lesions. No pig lesion were scored above grade 3. The general trend revealed that OC lesions were not severe and were low in frequency, (23% of the 160 pigs had lesions either radiologically and/or macroscopically). Also the A-E complex OC was less frequent than the physeal type. Humeral condyle OC was more frequent (5%) than the femoral condyle OC (3%). The distal ulna physeal OC was the most severe (6.3%) and had a highest frequency (19%) than that in other phases. The proximal ulna and anconeal process had marked synovial fossae. Also the presence of growth arrest lines was a prominent radiographic feature in most of the animals.

INTRODUCTION

In commercial pig farming countries osteochondrosis (OC) is a major predisposing factor to lameness, leg weakness, as well as poor performance in breeding pigs (Hill, 1990a,b). Osteochondrosis is defined as a generalized, nonfatal pathologic skeletal disease of unknown origin affecting several animal species (Craig and Riser, 1965; Hill *et al.*, 1984a). Osteochondrosis has high morbidity and it is characterized by the failure of degeneration of cartilage for pre-forming immature bone. This results into retention of abnormally thick cartilage (Bullough and Heard, 1967; Grøndalen, 1974a; Reiland, 1978a; Olsson and Reiland, 1978; Kincaid and Lidvall, 1983; Kincaid *et al.*, 1985; Bittegeko, 1995). Radiologic examination of the bone is a well known noninvasive diagnostic technique. It has been used in the diagnosis of osteochondrosis in human beings, horses, dogs, pigs and other animals (Stromberg and Rejno, 1978; Johnson *et al.*, 1980; Hill *et al.*, 1984b; Bittegeko, 1995; Bittegeko and Arnbjerg, 1994a,b; 1997; Bittegeko *et al.* 1997).

In pigs osteochondrotic lesions are reported to occur more frequently and severe at two sites of endochondral ossification in long bones. These are the articular-epiphyseal cartilage (A-E) complexes and the physeal growth plates (Grøndalen, 1974a,b, 1981; Reiland, 1978a; Bittegeko, 1995; Bittegeko and Arnbjerg, 1994a,b). Some authors claim that there is a tendency of being bilateral and symmetrical (Reiland, 1978a,b; Olsson and Reiland, 1978).

Osteochondrosis has been reported to affect some specific sites of the skeleton more frequently than others. The medial condyles of the femur and humerus are the commonest sites of articular-epiphyseal cartilage osteochondrosis in the pig (Nakano *et al.*, 1987; Bittegeko 1995). Walker *et al.*, (1966); Jussila and Paatsama, (1972) reported radiological lesions in the distal ulna in pigs under experimental limb immobilization. The distal ulna metaphyseal growth plate is postulated to be the most severely and frequently affected of all physes (Grøndalen, 1974a,b,c, 1981; Reiland, 1978a; Bittegeko and Arnbjerg, 1994b, 1997). The definitive cause of osteochondrosis is still unknown, despite a lot of literature concerning the horse and other species (Olsson, 1978; Jubb *et al.*, 1993). Osteochondrosis seems to be the result of a long-term selection for desirable carcass qualities combined with intensive management techniques.

There has been contradicting ideas about the influence of nutrition and growth rate on the prevalence and severity of OC lesions.
While Nakano *et al.* (1984) reported the lack growth rate influence, Carlson *et al.* (1988) reported the presence of the influence of growth rate on the prevalence and severity of OC lesions. There are no records

in literature on the status of osteochondrosis in slow growing pig in the tropics.

The present study was to establish the frequency and degree of severity of OC in the slowly growing Landrace pigs in Tanzania at slaughter weight (70-90kg live-weight). The pigs were originally introduced from western Europe, thus having the same genetic back ground as the ones raised in European commercial farms. Standard radiologic, micro-radiographic and macroscopic techniques, together with histologic examination were employed to confirm the diagnosis.

MATERIALS AND METHODS

A total of 160 Landrace pigs from Melela Bustani Catholic Integrated Farm (100) and small holder farmers (60) in Morogoro Tanzania were used in this osteochondrosis survey study. Radiologic examination was done in all 160 pigs, while macroscopic and histologic examinations were done only in 60 pigs. Small holder farmers in this study were those keeping 2-10 pigs each. The pigs were fed maize husks/bran, raw sources of carbohydrates (e.g cassava, potatoes, and yams), greens, and in a few cases Soya seed cake, mineral supplement and sardines. Water was given ad-libitum. Although the nutritive quality and value of the feed given was undetermined, it was assumed to be lower in protein and minerals compared to the one used in intensive pig farming in the European countries. The pigs were housed in simple pens, with either concrete, woody or soil floor. Ventilation was very high as the walls of the pens were short and the roof high. The average area was 2-3 m^2. and the pigs could just manage to move around in the pen and therefore exercises were limited. In general, the growth rate was low, because the pigs attained slaughter weight (70-90kg) at the age of 8-10 months compared to commercial farm pigs which attain the same slaughter weight at 4-5 months. The genetic back ground of all pigs was not known, but had been brought in Morogoro from western Europe countries, therefore they were assumed to be the same genetic background as those in Europe.

The carpal, elbow, tarsal and knee joints of left thoracic and pelvic (fore and hind) limbs of 160 carcasses were examined. The left side was chosen as lesions in osteochondrosis are believed to be bilateral and symmetrical and therefore assumed to reflect observations on the whole animal(Reiland, 1978a; Hill *et al.*, 1984a; Bittegeko and Arnbjerg, 1994a,b: Bittegeko, 1995). All samples were radiographed in the medio-lateral and antero-posterior projections just after slaughter. Radiographs were produced using the X-ray cassettes with "3M Trimax 16" screens and Fuji HR-L films, FFA was 100 cm. The Portable X-ray Unit, Santax, Type SP 103, (100 KV, 35 mA, 30 Kw, SHOWA x-ray Co. Ltd. Tokyo Japan). The films were processed manually. The radiographic features of osteochondrotic (dysplastic) lesions were scored according to Bittegeko and Arnbjerg, (1994a,b) as shown in Table 1 and 2.

After radiography, the joints of 60 pigs were opened and examined for gross lesions of OC. Further more, in the affected bones, slabs were cut through the lesion area, examined for gross lesions and then micro-radiographed. Examples were authenticated histologically. The classic Chi-squared test and Wilcoxon rank sum tests were used to test, compare and verify the lesions severity significance between different sites.

Table 1. The scoring system for epiphyseal osteochondrosis radiologic lesions (Bittegeko and Arnbjerg, 1994a).

Grade	**Description of lesions**
1	Smooth subchondral bone surface, no radiolucent areas or foci in the subchondral bone: (**Normal**).
2	Smooth subchondral bone surface, with few moderate foci of irregular ossification / radiolucent foci in the subchondral bone: (**Mild**).
3	Irregularities in subchondral bone surface, with marked areas of radiolucency / irregular ossification in the subchondral bone: (**Moderately Severe**).
4	Irregularities in subchondral bone surface, with large areas of radiolucency / irregular ossification in the subchondral bone and/or defects in the epiphysis: (**Severe**).
5	Large defects in subchondral bone and/or the presence of dissecting lesion, with or without arthrotic changes: (**very severe**):

Table 2. The scoring system for physeal (metaphyseal) osteochondrosis radiologic lesions (Bittegeko and Arnbjerg, 1994b).

Grade	Description of the lesions
1	Slender physis, smooth physeal-metaphyseal and physeal-epiphyseal margins, no metaphyseal radiolucent foci/areas, no metaphyseal flaring, lipping and slipping of epiphysis:(**Normal**).
2	Widened physis and metaphysis, metaphyseal lipping, small foci of irregular ossification: (**Mild**).
3	widened physis and metaphysis, marked area(s) of irregular ossification and /or radiolucency: (**Moderately Severe**).
4	Widened and deformed physis and metaphysis, very irregular ossification and/or large areas of radiolucency in the metaphysis:(**Severe**).
5	Very widened and deformed physis and metaphysis, very irregular ossification and/or very large areas of radiolucency in the metaphysis:(**Very Severe**).

RESULT

Osteochondrotic lesions were observed on radiographs in 37 (23%) out of 160 pigs (Fig. 1 to 5). Figure 2a shows grade 1 score of physis.

Epiphyseal OC was registered in humeral and femoral condyles at the frequency of 5% and 3%, respectively. All lesions were scored grade 2 except one humeral condyle case which was scored grade 3. In this study the humeral condyles seem to be more frequently affected (Fig.3) than the femoral condyles ($X^2_{(Yates)}$=16.43; P<0.005); (Fig.1). The proximal ulna and anconeal process had marked synovial fossae (Fig. 3 & 5). The physeal (metaphyseal growth plate) osteochondrosis (dyschondroplasia) was severe and frequently observed in the physis of the distal ulna (grade 2 = 12.5% and grade 3 = 6.3%), (Fig. 1 & 2b). ($X^2_{(Yates)}$=20.12; P<0.005). The distal radius lesions were mainly scored grade 2 (9.4%) and grade 3 (0.6%). The distal tibia and fibula were scored at grade 2 (0.6% & 1.9%) and grade 3 (0.6% & 1.2%) respectively (Fig. 1). No OC lesions were observed in the physes of the

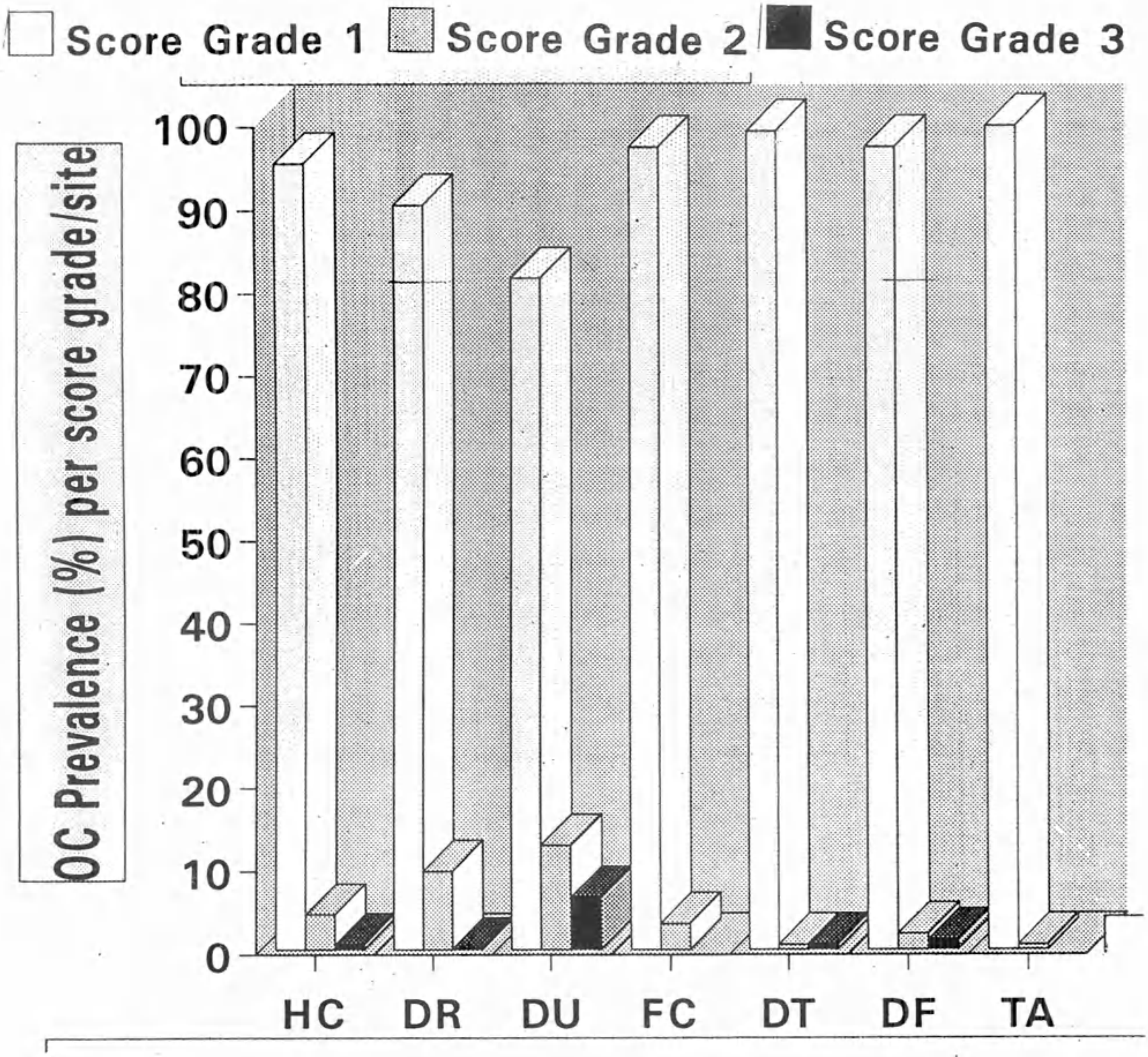

Fig. 1: The prevalence and severity of OC lesions in slow growing landrace pigs in Tanzania (n=160). humeral condyle (HC), distal radius (DR), distal ulna (DU), femoral condyle (FC), distal tibia (DT), distal fibular (DF) and tallus (TA),

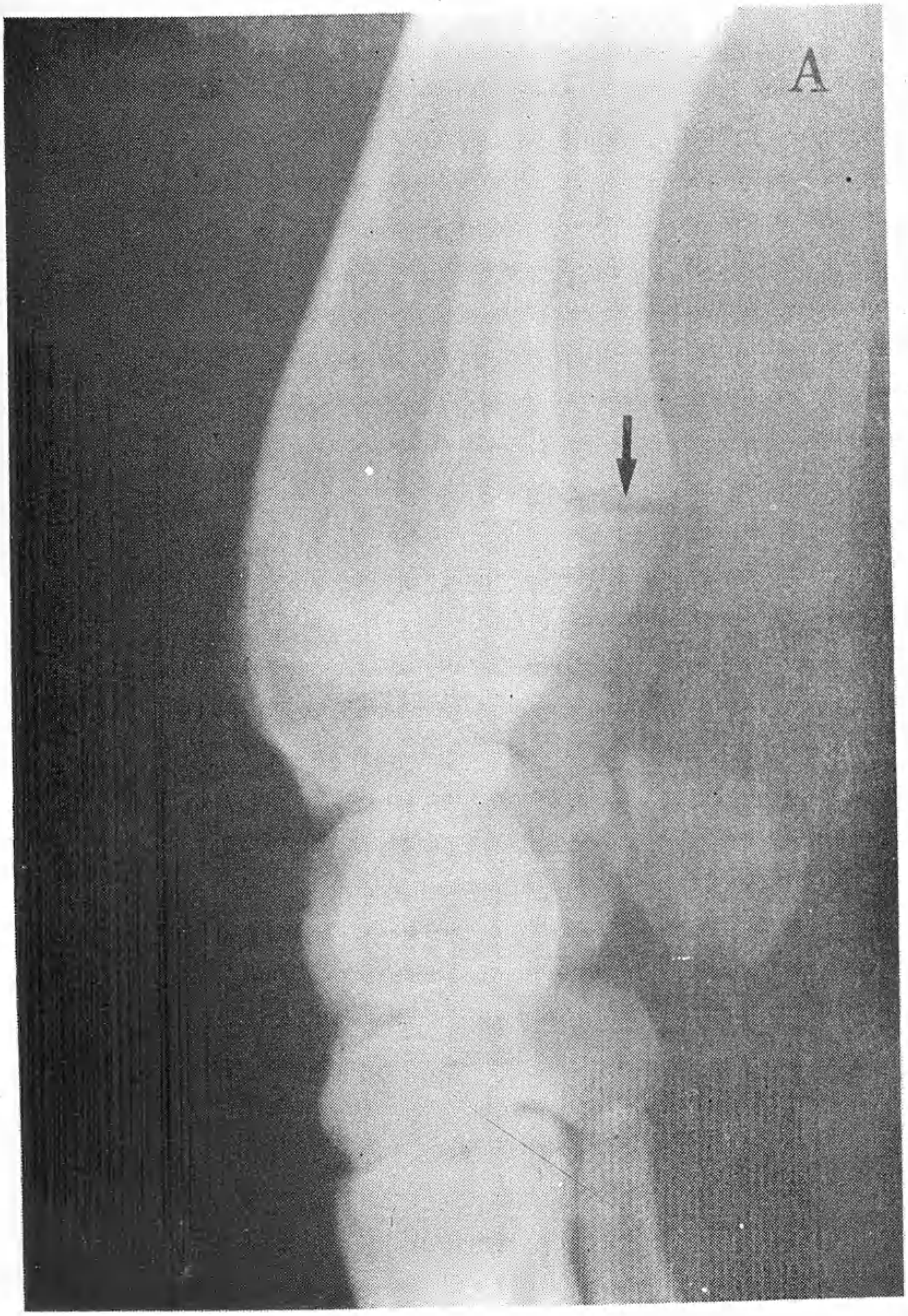

Fig. 2A: The radiograph showing score grade 1 that is normal distal ulna physis (arrow).

B

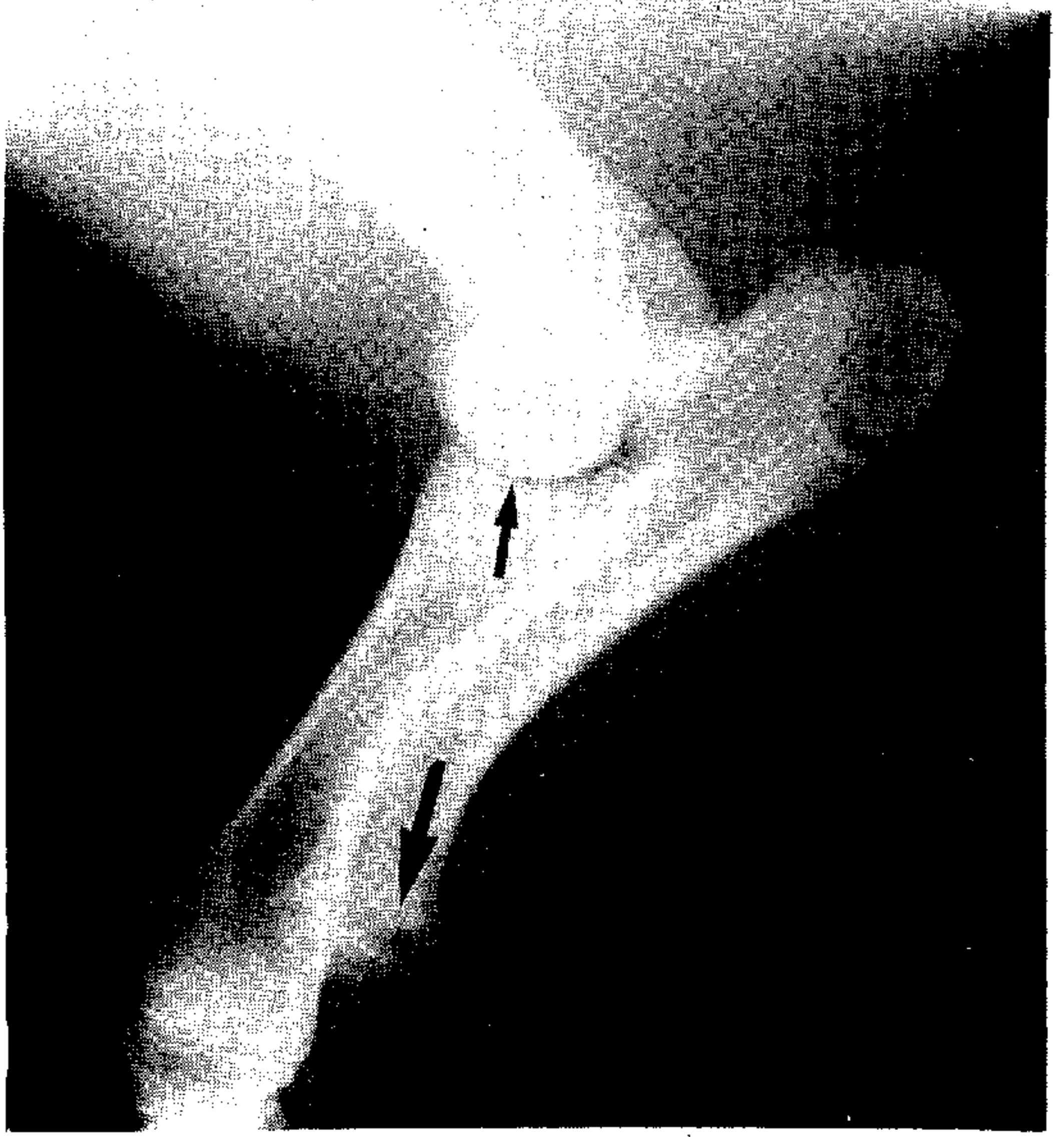

Fig. 2B: A radiograph showing distal ulna physeal dyschondroplasia lesions (big arrow) and a normal humeral condyle (small arrow).

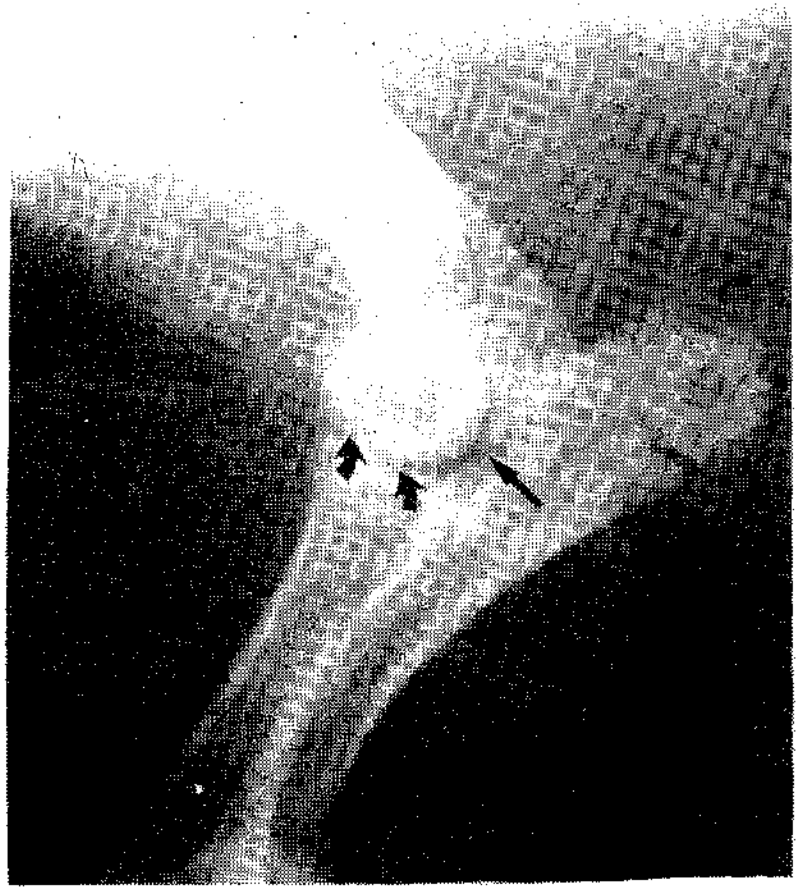

Fig. 3: A radiograph showing humeral condyle osteochondrotic lesion (short arrows) and synovial fossae (straight arrow).

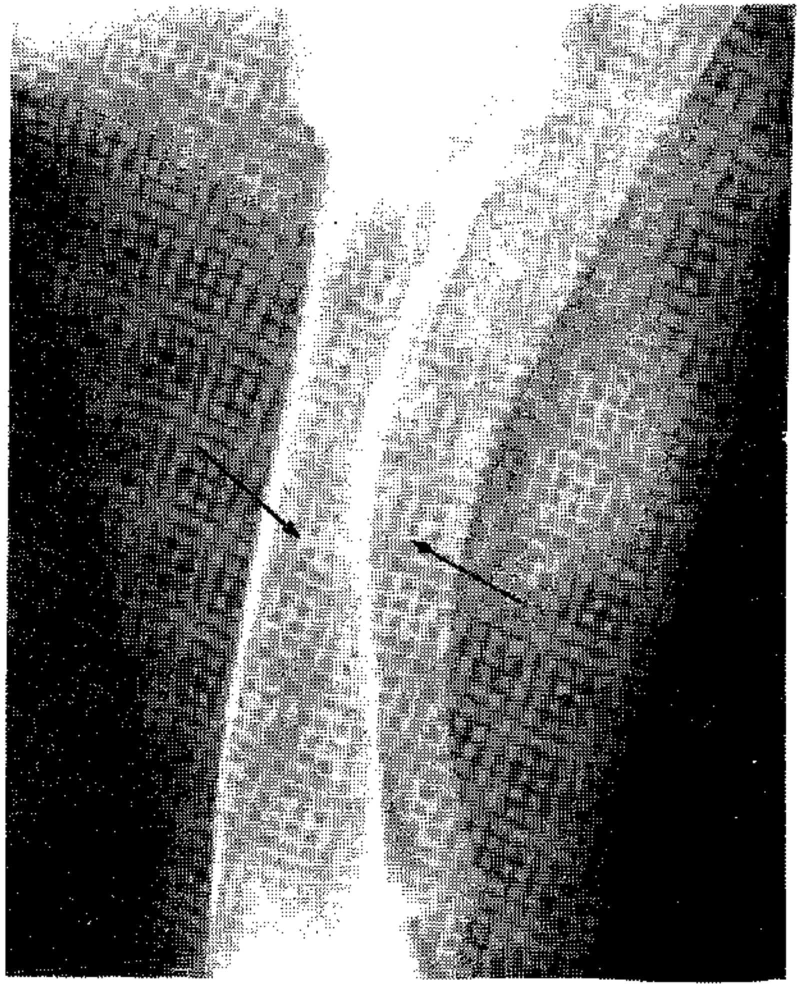

Fig. 4: A radiograph showing growth arrest line in the radius and ulna medullary cavity (arrows). Note the normal physeas

Fig. 5: A radiograph showing the synovial fossae lessions on the proximal ulna (curved arrow) and a normal humeral condyle (straight arrow).

distal humeral and femoral, or in the physes of the proximal tibia and fibula (Fig. 1). This was further confirmed micro-radiographically on bone slabs and histologically. Growth arrest lines was a common radiographic feature in long bones (Fig. 4).

DISCUSSION

Osteochondrosis in pigs predispose to leg weakness, pain and lameness which may lead to economic losses. Poor performance is also a common feature in breeding sows and boars. However, the cause of the condition is not well understood (Reiland, 1978a,b; Olsson, 1978; Hill *et al.*, 1984a,b; Hill, 1990a,b).

OC lesions in slaughter age pigs have been described in detail macroscopically and histologically at postmortem examination of opened joints (Bullough and Heard, 1967; Grøndalen, 1974a; Reiland, 1978a; Bjorklund and Svendsen, 1980; Bhatnagar *et al.*, 1981; Kincaid and Lidvall, 1983; Hill *et al.*, 1984,b; 1985; Carlson *et* al., .1986; Hill et al., 1990). Few reports on radiological description of the OC lesion are available (Bittegeko and Arnbjerg, 1994a,b; Bittegeko, 1995,1996). Radiologic developmental course of the lesions of epiphyseal OC in younger animals has also been described by Bittegeko and Arnbjerg, (1994a), There is scanty information about OC in pigs raised by small holders in the tropics. The pigs raised in the tropics are using varying quantity and quality feed, leading to slow growth rate (Bittegeko, 1995; Bittegeko et al. 1997).

This study demonstrates typical radiological OC lesions affecting 23% of the 160 animals examined, and only low grades of lesions were observed. This indicates that dyschondroplasia (OC) is present at low level in pigs fed low plane diet and growing slowly. This is in contrast with the intensively raised pigs on high plane feeds and fast growing, where the morbidity is high and the incidence is believed to be up to 100% (Bullough and Heard, 1967; Grøndalen, 1974a; Reiland, 1978a; Olsson and Reiland, 1978; Kincaid and Lidvall, 1982, 1983; Kincaid, et al. 1985; Bittegeko and Arnbjerg, 1994a,b; Bittegeko et al. 1997). It was also noted only 7% had a score of grade 3 which this indicates that even the severity of the lesions was lower compared to those reported from intensively raised, high plane diet fed and fast growing pigs (Bittegeko and Arnbjerg, 1994b).

Assuming that animals used in our study had the same genetic back ground as the that of Swedish, Norwegian and Germany landrace breeds which had been reported to have more frequent and more severe osteochondrosis lesions (Grøndalen and Vangen, 1974; Goedegebuure, et al. 1980; Lundeheim, 1987). The differences between the pigs raised in commercial production farms in Europe and the small holder farms in Tanzania are the managemental and the environmental factors. The only important factor which can be singled out is the plane of nutrition. The pigs were fed low plane feeds and in small quantity compared to the ones in european commercial farms. This was indicated by their slow growth rate compared to the pigs from commercial farms in Europe.

However, it was surprising, that 23% of the 160 pigs examined had radiological osteochondrotic lesions. These findings are indirectly supported by Grøndalen, (1974a-f), who noted that causes of osteochondrosis may include **overloading of cartilage and bone tissue, and poor stability of the joints due to weak muscles, ligaments and unsuitable joint shape.** These were assumed to be

Table 3. The variation of A-E complex and physeal dyschondroplasia (osteochondrosis) radiologic lesions severity in Tanzanian Slaughter pigs, (n=160).

Part of the bone	Number of pigs & frequency (%) per Osteochondrosis lesions grade score: (n=160)				
	1	2	3	4	5
Humeral condyles	152 (*95.0%*)	7 (*4.4%*)	1 (*0.6%*)	0	0
Proximal Radius	158 (*98.8%*)	2 (*1.2%*)	0 (*0.0%*)	0	0
Proximal Ulna	140 (*87.5%*)	15 (*9.4%*)	5 (*3.1%*)	0	0
Anconeal Process	148 (*92.5%*)	7 (*4.4%*)	5 (*3.1%*)	0	0
Distal Radius	144 (*90.0%*)	15 (*9.4%*)	1 (*0.6%*)	0	0
Distal Ulna	130 (*81.2%*)	20 (*12.5%*)	10 (*6.3%*)	0	0
Femoral condyles	155 (*96.9%*)	5 (*3.1%*)	0 (*0.0%*)	0	0
Proximal Tibia	160 (*100%*)	0 (*0.0%*)	0 (*0.0%*)	0	0
Proximal Fibula	160 (*100%*)	0 (*0.0%*)	0 (*0.0%*)	0	0
Distal Tibia	158 (*98.8%*)	1 (*0.6%*)	1 (*0.6%*)	0	0
Distal Fibula	155 (*96.9%*)	3 (*1.9 %*)	2 (*1.2%*)	0	0
Talus	159 (*99.4%*)	1 (*0.6%*)	0 (*0.0%*)	0	0
Tarsal bones	160 (*100%*)	0 (*0.0%*)	0 (*0.0%*)	0	0

These were assumed to be caused by rapid growth and rapid/fast weight gain. These two could be due to Nutritional and/or Genetic factors (Grøndalen, 1974a-f; Nakano *et al.*, 1978; 1979). In this study the plane of nutrition was the only important factor singled out to be different from the same studies carried out in European commercial farms. Therefore this may explain why the growth rate and the weight gain were low and also why the frequency and severity of the lesions were low. While Nakano *et al.* (1984) noted no influence of growth rate on OC lesions, Carlson *et al.* (1988) noted that gilts having higher average daily weight gain had increased prevalence and severity of OC lesions, compared to their counterparts having a lower average weight gain. The findings in this study, are in agreement with Carlson *et al.* (1988).

It is concluded that osteochondrotic lesions are less severe in pigs fed low plane feeds compared to those on high plane feeds. Therefore the quality and quantity of the feed have an influence on the prevalence and severity of OC lesions.

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