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Resection of the distal interphalangeal joint in cattle: an alternative to amputation

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A technique for the resection of the distal interphalangeal joint of cattle with infectious arthritis of the joint is described. The procedure has advantages over amputation of the digit because a weight-bearing claw is retained so that the animal can move on slatted floors and at pasture, and its productive life can be extended.

LAMENESS is one of the main welfare and economic problems of the dairy industry. Surveys of the numbers of lame cattle treated by veterinarians suggest an average incidence of the disease ranging from 4.7 per cent (Eddy and Scott 1980) and 5.5 per cent (Russell and others 1982) to 30 per cent (Prentice and Neal 1972). Whitaker and others (1983), who counted animals which were lame but not treated by a veterinary surgeon, reported an average incidence of 25 per cent in one year with a financial loss to the British dairy industry of £35 million. The losses were due to culling, reduced milk yields, treatment costs and decreased fertility (Lucey and others 1986).

In spite of the scale of the problem, there appears to be little research going on into the prevention and treatment of lameness in cattle. In July 1989 *The Veterinary Record* reported that it had published only eight articles on lameness in dairy cattle during the previous five years, compared with 278 articles on other health problems of dairy cattle such as parasitism and mastitis. Although the main effort should clearly be directed towards preventing lameness, improving the methods of treatment is of particular concern to the veterinary surgeon in practice. This article describes the technique used at the Munich Veterinary Faculty for the treatment of infectious (septic) arthritis of the distal interphalangeal joint of cattle. Although

different methods of distal interphalangeal joint resection have been described in the German literature since 1913 (Hess 1913), the surgical procedure is only briefly mentioned in English publications (Greenough and others 1981, Greenough and Ferguson 1985, Greenough and Johnson 1988). Recently, a simplified technique for the treatment of deep foot infections involving the distal interphalangeal joint has been described by Blowey (1990).

Infectious arthritis of the distal interphalangeal joint

Infectious, or purulent, arthritis of the distal interphalangeal joint in cattle constitutes between 3 per cent (Greenough 1963) and 10.6 per cent (Hortig 1979) of all foot conditions. The most common cause of the disease is deep ulceration of the sole, but other septic processes of the digit extending to the joint or a deep white line abscess may also be responsible. Infection of the joint rarely occurs via the haematogenous route.

An affected animal becomes moderately to severely lame, the coronet of its diseased claw is usually swollen, and the adjacent skin often becomes erythematous. If an ulcer is present in the sole, it is frequently possible to probe directly on to bone. A marked pain response is evoked by applying pressure to the claw. In longer-standing cases the toe tilts upwards because the necrotic distal part of the deep digital flexor tendon either loosens or becomes completely detached from its insertion onto the distal phalanx. The animal usually loses weight.

Radiography may be used to confirm the diagnosis. Two projections should be taken: a dorsoplantar (or dorsopalmar) view, using an 18 × 24 cm cassette, and an oblique lateral view of the diseased claw obtained by placing a small (9 × 12 cm) non-screen film into the interdigital space (Fig 1b). The beam should be at an oblique angle (about 45°) to claw and film, because a straight lateral view at 90° usually fails to include the joint. The main feature of an infected distal interphalangeal joint is a marked widening of the joint space when viewed in a dorsoplantar (or dorsopalmar) direction (Fig 1a). Early in the course of the disease, this widening is due to an increase in joint fluid; later the appearance becomes more marked as the

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FIG 1a: Five-year-old Deutsche Fleckvieh cow. Dorsoplantar projection of left hind (HL) foot. Purulent arthritis of the lateral distal interphalangeal joint. There is extensive soft tissue enlargement, and the joint space is markedly enlarged



FIG 1b: Lateral projection of lateral claw. Main features are osteolytic changes at the tuberculum flexorium and distal sesamoid, with metaphlastic calcification of part of the distal deep digital flexor tendon

subchondral bone on either side of the joint is destroyed (Bargai and others 1989). Other radiographic features are periosteal new bone formation on the distal and middle phalanges and in severe cases also on the proximal phalanx, marked soft tissue swelling, as well as areas of osteolysis at the insertion point of the deep digital flexor tendon (tuberculum flexorium), at the surface (usually ventral) of the distal phalanx, and within the distal sesamoid (navicular) bone (Fig 1b).

If a clinical examination, with or without radiography, shows that the infection has already spread proximally (for example, there is osteolysis at the proximal interphalangeal joint and marked osteophyte growth at the proximal phalanx), a high amputation through the middle of the proximal phalanx is the only option. The second claw should always be carefully examined because for this operation a healthy partner claw is essential.

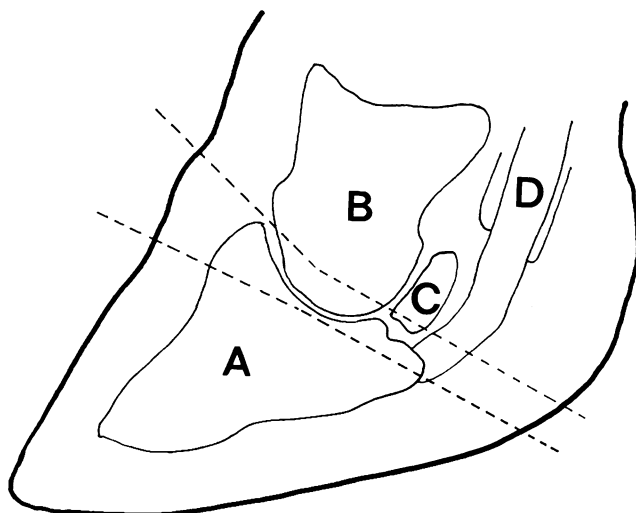


FIG 2: Schematic diagram of distal interphalangeal joint, longitudinal section. A Distal phalanx, B Middle phalanx, C Distal sesamoid, D Deep digital flexor tendon. Dotted lines indicate area to be resected

Surgical technique

The distal interphalangeal joint can be resected while the animal is standing, provided that the animal is adequately restrained; however, for greater precision and for the comfort of the operator it is preferable to have the animal in lateral recumbency, with the diseased claw uppermost. The risk of radial paresis or pressure damage to the limb musculature can be avoided by placing padding beneath the lower forelimb. Food should be withheld for 12 hours before the animal is cast on to a hydraulic table. It has been found that sedation with xylazine is rarely required. Heavily pregnant cows should not be cast but should be restrained in a cattle crush.

The foot is clipped and washed, and an elastic tourniquet placed around the metatarsus/metacarpus. Regional anaesthesia is obtained by injecting 20 ml of a 2 per cent solution of lignocaine, without adrenaline, into any accessible subcutaneous vein distal to the tourniquet. The lateral digital vein immediately proximal to the fetlock joint is usually the most convenient site. The tourniquet gives the additional advantage of controlling haemorrhage during the operation. Lastly, the horn in the heel and caudal sole region is pared away until it can easily be indented by digital pressure; otherwise an incision with a scalpel blade will prove difficult. An electric sanding machine can be used to thin the horn rapidly.

The skin incision should begin immediately distal to the accessory digit and continue distally into the heel of the claw, ending in an oval around the necrotic tissue, in the caudal third of the bearing surface. The oval piece of sole horn is removed, and, using a clean blade, the incision is deepened until the deep digital flexor tendon is reached. This structure is transected below the annular ligament, about 2 cm distal to the accessory digit. The tendon is dissected free and detached from its insertion into the distal phalanx. In many cases the detachment has already taken place owing to the necrosis of the distal portion of tendon. The distal sesamoid is then removed after first cutting the axial, abaxial and distal sesamoidean ligaments, thus exposing the distal interphalangeal joint.

The first stage in resection of the joint is to curette the tuberculum flexorium of the distal phalanx and then the cartilage of the distal end of the middle phalanx (Fig 2). Then, using an electric (eg, Bosch Scintilla SA, 500 W, 27,000 rpm) or pressurised air powered drill, with a bit diameter of approximately 6 mm, a hole is drilled from the ventral entry point through the centre of the distal interphalangeal joint to emerge at the dorsal surface just below the coronary band. The hole is widened axially and abaxially until all the necrotic bone has been removed. The remaining healthy bone appears white and is well vascularised, in contrast to the yellow/grey necrotic bone.



FIG 3: Four-year-old Deutsche Fleckvieh cow. Dorsoplantar projection of left hind (HL) foot, four months after resection of the lateral distal interphalangeal joint. The remaining axial and abaxial joint surfaces have fused. There is marked periosteal proliferation at the middle phalanx and a slight subluxation of the distal phalanx

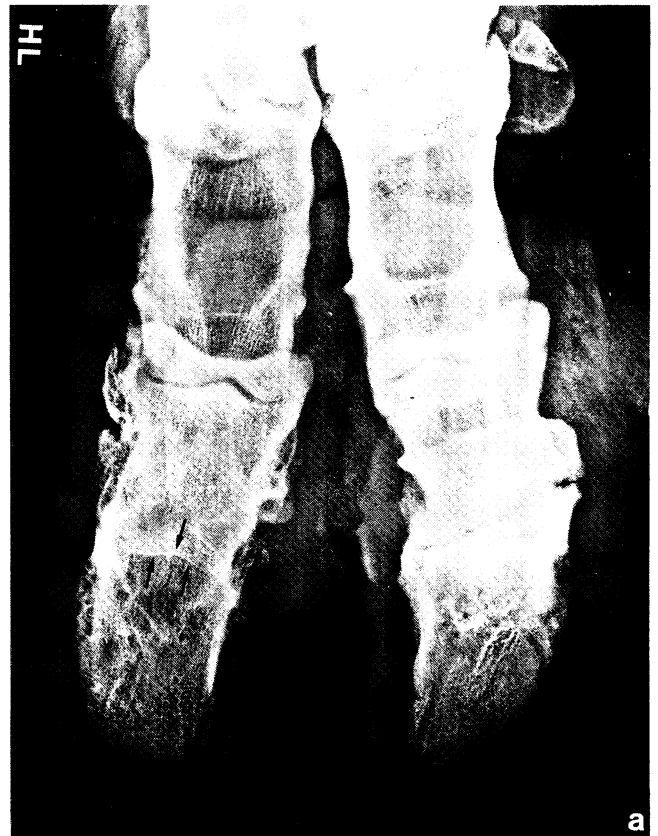


FIG 4: Same animal as in Fig 1, two years after resection of the lateral distal interphalangeal joint of the left hind (HL) foot. Complete joint ankylosis has taken place; small amount of cartilage remains (arrows). All three lateral phalanges show periosteal proliferation

The drilling should be interrupted at intervals to allow debris to be flushed away with cold sterile water, and to prevent damage to healthy bone through over-heating. If possible, a small area of joint should remain axially and abaxially to facilitate a more rapid ankylosis (Fig 3). With experience, the procedure takes about 15 minutes.

Once any remaining necrotic bone or tissue has been removed, oxytetracycline powder is applied to the wound, which is then packed with cotton gauze soaked in iodine solution. The wound is not sutured. A tight waterproof bandage is bound around the claw and it is prevented from weight-bearing by attaching a shoe to the other claw. In this clinic a metal shoe is nailed onto the claw and is raised by a wooden block screwed to its lower surface. This shoe can be easily removed and re-applied, and has the advantage that a metal extension, welded onto the toe, can be bent over the tip of the operated claw to prevent it from becoming ankylosed in dorsiflexion. An alternative method, more applicable to general practice, is to attach a wooden shoe to the unoperated claw by means of a polymer resin, and wrap a length of elasticated bandage tightly around the operated claw and shoe in a figure-of-eight pattern until the operated claw is in the desired position. Parenteral antibiotic cover is given for five to seven days after the operation and the bandage is renewed two or three times at weekly intervals. After two weeks the wound is covered by granulation tissue and the animals are slightly to moderately lame and starting to regain weight. Five to six weeks after the operation the bandage is changed for the last time and the shoe is removed, the final bandage being removed by the owner two to three weeks later.

Discussion

By far the most common surgical technique currently used to treat purulent arthritis of the distal interphalangeal joint is

amputation of the affected digit. This operation is simple to perform, requires little specialised equipment and usually ensures rapid relief from pain and return to normal productivity. However, with only a single digit on one foot, the animal can no longer be kept in accommodation with a slatted floor, walking at pasture is difficult and the remaining digit has to bear extra weight, with an increased risk of it becoming diseased, especially in heavy cows and bulls, with fatal consequences. Amputation remains the preferred treatment if it is not intended to retain the animal for long, for example, a beef animal close to its slaughter weight or a cow with a low economic value. In contrast, after joint resection, although the function of the ankylosed digit is reduced, it still plays a part in bearing weight; movement at pasture and on slatted floors remains satisfactory and it may even be possible to apply a shoe to the operated digit if, at a later date, the second claw should require treatment. These advantages make it a more suitable technique to apply to valuable animals or to those from which a long productive life can still be expected. If successful, the procedure allows a cow to have several more lactations and is therefore economical whether it is carried out during or at the end of a lactation.

In a follow-up study (Ziffer 1980) animals were retained for an average of 13 months after amputation. In comparison, the average life-span after joint resection was 18 months (Nuss 1988, Köstlin and Nuss 1988) with a range from one month to seven years. The main reason for culling was infertility. Careful selection of the candidates for surgery is necessary to improve the average survival time. When there are signs of an advanced infection, with both digits of the foot involved or a high ascending cellulitis, surgery should not be contemplated. Any concomitant disease such as mastitis or endometritis would also worsen the prognosis.

The length of the initial longitudinal incision and the size of the resected portion of the heel permit good access to the distal part of the deep flexor tendon and the distal sesamoid bone.

This technique therefore dispenses with the need to apply dorsal traction to the toe so that the surgeon can visualise the sesamoid bone, distal tendon and joint, as described for the 'horizontal' approach (Greenough and Ferguson 1985).

Contrary to some reports (Greenough and Ferguson 1985, Greenough and Johnson 1988) constant irrigation of the joint for several days after the operation has not been found necessary. It is essential that all necrotic or altered tissue is removed at the time of the operation. Wound infection occurred in only 22 of 281 cases (7.8 per cent) which underwent a resection of the distal interphalangeal joint in the surgery department of the Ludwig-Maximilians University (Nuss 1988, Köstlin and Nuss 1988). Of these 22 cases, 15 recovered after further curettage. Of the 281 animals, 220 (78 per cent) recovered without complications. However, these figures relate to a specialist clinic where about five distal interphalangeal joint resections are carried out for every one amputation of the digit, and where many cases are referred after having been treated at home for some time, either by the owner or by the local veterinary surgeon.

The most common complication was the development of an ulcer under the shoe (23 of 281 animals). Ascending cellulitis developed in seven animals and six of these were slaughtered. A further complication was a permanent upward tilting of the ankylosed claw, due to inadequate downward fixation during the healing phase. There are several techniques to prevent dorsiflexion during the healing phase in addition to those mentioned above. Under practice conditions it is seldom feasible to manufacture and apply metal shoes. The figure-of-eight elastic bandage is equally effective, but it must be replaced every time the bandage is changed. A further alternative is to pass a loop of thick wire (approximately 2 mm in diameter) through both claw tips, if there is sufficient horn. However, this technique allows more movement of the operated claw and the wire frequently breaks. Ankylosis of the resected joint space takes place within seven to 12 months after the operation (Fig 4);

the space left by the resected flexor tendon is frequently filled by a band of fibrous tissue.

The slightly higher cost of a joint resection compared with a digital amputation, which is due to the longer recovery time, appears to be justified by the retention of two weight-bearing claws, giving the animal a longer economic life. With correct patient selection, resection is a useful method of treating infectious arthritis of the distal interphalangeal joint.

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