Serial Bone Scanning of Colles Fracture

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Summary. Serial bone scannings with 99-M-Tc-MDP have been performed in 15 patients with an extra-articular dorsal-angulated fracture of the distal radius (Colles’ fracture). A method for the quantification of healing activity is described. The activity-ratios show a typical pattern of progress during the healing period. There is a correlation between fractures with high activity ratios late in the healing period and fractures that redisplace during the healing period.


Introduction

Serial scintimetry for the evaluation of fracture healing in tibial fractures has been reported by Muheim [5]. He suggested that serial scintimetry may be a useful tool for early detection of incipient non-union.

Lund et al. [3] performed serial bone scannings with Tcetium-marked pyrophosphate (TcPP) on undislocated fractures of the radius. They used a gamma camera connected to a computer and compared the activity over a small “region of interest” (ROI) on the fractured side with an equivalent area on the non-fractured side. They found that the activity was increased in the fracture area. The accumulation of TcPP was greater in the final stage of the healing period in those fractures that clinically had shown a slow healing rate.

In this paper, a new scintimetric method which quantifies the increase of activity that occurs in fractures is described. Scintimetric examination has been performed with a gamma camera connected to a computer. The change of accumulation of 99-m-Tecnetiummetylendiphosphonat (99-m-Tc-MDP) has been correlated to the occurrence of redisplacement in the fracture during the healing period.

Material and Methods

The method involves a gamma camera connected to a computer system for the storage of pictures and for estimation of counts at a single point in the frame of the gamma camera (pixel). The computer presents the picture from the gamma camera with isocountlines. An isocountline separates those pixels above a certain count level from those below this level (Fig. 1). The isocountlines allow the determination of the area with the highest uptake of Tc-MDP i.e. the region of interest (ROI). The accumulation of the bone seeking tracer is always greatly increased over the fracture area. The use of isocountlines for determination of the ROI ensures the inclusion of the area where the accumulation is greatest. This eliminates manual errors and should result in more reproducible results.

We have chosen an isocountline of 50%, that is, all pixels inside that line have a count of at least 50% of the maximum count of one pixel. In the case of radius fracture, we found that an isocount line of 50% gives an area of about 4-5 cm² (which with our camera represents 20-30 pixels).

In order to measure how the uptake of Tc-MDP varies between different examinations, uptake in the fracture is related to uptake in a reference area. The reference area should be
reproducible between different examinations and relatively immune to marking errors. Ideally it should constitute the corresponding area on the healthy side, to the automatically marked area on the fractured side. Since isocount lines cannot be used in the control area where the uptake is lower and more uniform, the reference area must be marked manually. In bone scanning of the distal part of the normal radius, small changes in position of the reference area resulted in large changes in the reference uptake values, since relatively high uptake is usual close to the radio-carpal joint. Thus, a small marking error may result in a large difference in the reference value. We preferred to mark the reference area 6 cm proximal to the radio-carpal joint, where the uptake is more homogenous. This 4 x 8 cm area covers both the radius and the ulna and corresponds to 10 x 20 pixels. The uptakes in the fracture area and the reference area are then divided by their respective areas. The activity ratio which is obtained is called the Q-ratio which means the average counts within the fracture area divided by the average counts within the reference area (Figs. 2 and 3). Scintimetric examinations were performed 1, 2, 4, and 8 weeks after the injury. 99m-Tc-MDP, 300 MBq was injected intravenously. A scintimetric examination could then be performed 3 h after the injection. The scintigrams were obtained with a gamma camera using a parallel hole collimator, and connected to the Gandalf computer system. The distribution of the bone seeking tracer was collected from the distal parts of both forearms and wrists by a gamma camera during 5 min. The pictures with a resolution of 64 x 64 pixels were stored on a disc memory. In order to obtain symmetric and reproducible pictures, a simple jig was built, whereby arm and hand were fixed in the same position at every examination (Fig. 4). The dorsal plaster cast was left in situ at the examinations after 1 and 2 weeks but removed after 4 weeks. The absorption in the dorsal plaster was insignificant, since the wrists were examined from the volar surface. The uncertainty due to random decay was in all examinations less than ±3%.

Fifteen patients, all women, aged 52-69 years were included in the study. Fourteen patients were examined at least 4 times, one patient only three times. Three patients had their first examination after about 2 weeks. Sixty-one scintigrams have been taken of these patients. All patients had a dorsal angulated extra articular fracture of the distal radius (Colles’ fracture). The fractures were reduced in local anaesthesia. The wrist was immobilized by a dorsal plaster cast with the forearm in pronation for 4 weeks [8]. X-rays with a lateral and an anterior-posterior view were taken before reduction. The...