ANALYSIS OF PHYSIOLOGICAL PATELLOFEMORAL CREPITUS

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The patellofemoral joint is a common source of pathology particularly in adolescents. In these patients often only the cartilage is diseased. Diagnosis therefore, from routine x-rays is not possible. A confirmatory diagnosis often requires arthroscopy. This necessitates hospital admission and a minor operation with the risks of an anaesthetic. There is therefore a need for a simple non-invasive outpatient diagnostic test to detect cartilage pathology. We are hoping to develop such a system using vibration arthrography.

This, although a new technique, has already been proven of value in the diagnosis of meniscal lesions (1). The transducer known as an accelerometer is illustrated in figure 1. This is attached to bony prominences around the knee. Our present project involves using a computer based system to record "joint sounds" from the normal patellofemoral joint, particularly "physiological patellofemoral crepitus (P.P.C.). This is the name we have given to the fine creaking sensation that can be felt on all normal patellae when the knee is moved slowly. An example of the signal is shown in figure 2.

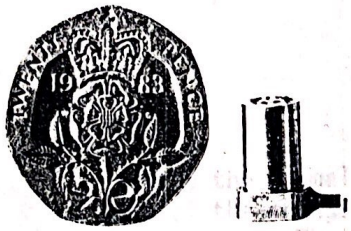

Fig. 1

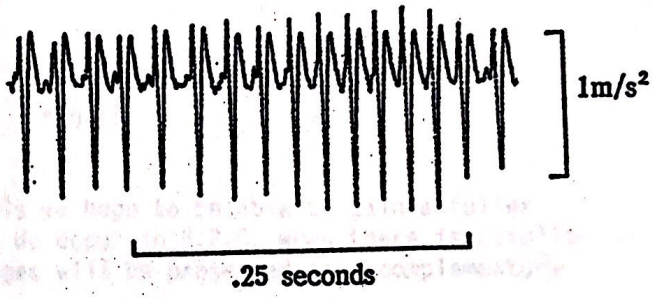

Fig. 2

We have been able to demonstrate that the cause of this phenomenon was self induced, rigid body vibration of the patella, occurring as a result of stick slip friction at the articular surface interface. This produces a series of transient oscillations of the patella. It had been previously thought that the signal was transmitted through the patella in a continuous fashion, like sound waves travelling through air.

The signal analysis package includes the F.F.T. which is characterised by the peak frequency (2). However because the P.P.C. signal is made up of a series of discrete transients, rather than being continuous, the peak frequency parameter becomes unreliable. We have altered the program to calculate two separate frequencies, firstly the repetition frequency of the series of transients and secondly the inherent peak frequency and weighted mean frequecy of each transient forming the series. An example of the analysis program is shown in figure 3. As can be seen the repetition rate, or slip frequency of the transient signals produces a banding effect. The

peak frequency reflects the slip frequency by always being a multiple of it, whereas the weighted mean frequency reflects the inherent frequency of each transient more accurately.

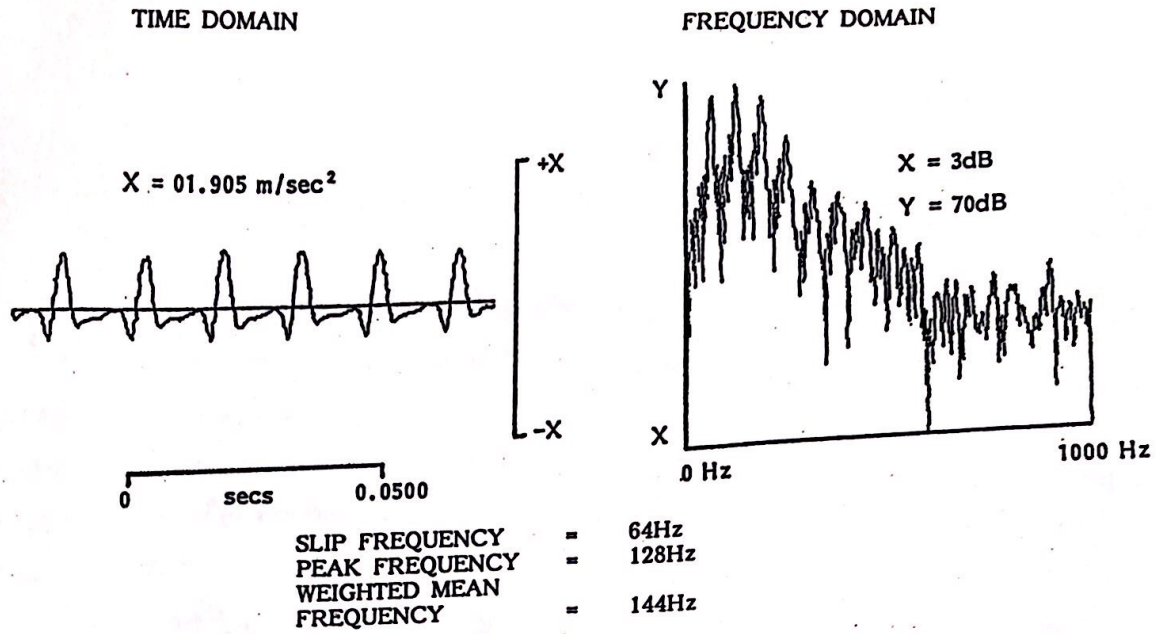

Fig. 3

In understanding the normal signals we hope to be able to gain a fuller understanding of the changes that do occur in P.P.C. when there is patello-femoral pathology. These changes will be presented in a complementary poster presentation (3).

1 McCrea, J.D., McCoy, G.F., Kernohan, W.G., McClelland, C.J., Mollan, R.A.B. "Vibrationsarthrographie in der diagnostik von kniegelenkskrankheiten". Zeitschrift fur Orthopadie, 1985; 123: 18-22.

2 Kernohan, W.G., Mollan, R.A.B. "Microcomputer analysis of joint vibrations". J. Microcomputer Appl. 1982; 5: 287-296.

3 Beverland, D.E., Kernohan, W.G., Mollan, R.A.B. "Parameters of physiological patellofemoral crepitus". Proc. Biol. Eng. Soc. Cambridge 1985.