

# ORIGINAL

## SUMMARY

**UNILATERAL Inflammatory knee joint disease in children leads to temporary lengthening of the affected limb due to accelerated growth. This effect is mirrored by the growth of the tail bones of experimental mice subjected to increased environmental temperature.**

Inequality in the length of limb, especially the lower limbs, is of considerable clinical interest. Despite extensive work describing the clinical features and efforts designed to correct limb inequality either by shortening the long limb or lengthening the short limb (4, 5, 17, 18, 22) little attention has been focussed on the effects of local heat on the growth plate.

The purpose of this paper is to draw attention to the closely parallel phenomena of premature limb lengthening in patients with monoarticular inflammatory disease and accelerated completion of the growth of tail vertebrae induced by exposing growing mice to raised environmental temperature (1).

## PATIENTS AND METHODS

### Case No. 1

B.P.Z. (F), born 3.10.1968. April 1969 : had intermittent swelling of right knee. 1973 : X-ray showed increase in size of lower femoral epiphyses. Diagnosis :

## Unilateral Inflammatory Articular Disease causing Limb Inequality : An Interpretation in the Light of the Effects of Local Temperature on Bone Growth

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synovitis. January 1975 : right leg 2 cm. longer than left. 22.7.1975 : synovectomy : villonodular synovitis. Manipulation under general anaesthesia resulted in a supracondylar fracture which required immobilization with Plaster of Paris Splint. Fourteen weeks later : further operation to cut the

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adhesions between the supracondylar pouch and the patella was carried out. Five manipulations were then performed. January : 1976 : flexion contracture, extension lag 4°, flexion lag, "nasty gait". 28.5.1976 : warm bony swelling of right quadriceps. Range of movements 25 - 70°. The right leg was 3 cm. longer than left. X-ray : osteoporosis and irregular bone density of lower right femoral metaphysis.

### Case No. 2

R.J. (F), born 8.2.1969 : July 1975 : fall from a bicycle swelling of right knee. Aspiration of right knee : few cells but sterile, A.F.B. negative. Arthroscopy and biopsy : monoarticular rheumatoid arthritis. 27.1.1976 : right knee swollen and shows excess fluid and synovial thickening. The right knee flexed as the left. No. flexion contracture, 1 cm. of muscle wasting in the right calf and thigh. The right leg is 2.5 cm. longer than left. Most of the differences in the tibia. 10.8.1976 : slight wasting of right thigh and calf. Trace of fluid still in right knee which is soft, cool and not tender. The distance from the anterior superior iliac spine to heel is 77.5 cm. on the right side and 76.5 cm. in the left side. 6.10.1976 inequality 1 cm.

### Case No. 3

N.K. (F), born 20.6.1969 : at the age of 2 years 2 months : onset of monoarticular rheumatoid

arthritis of right knee. 16.8.1976 : right leg longer than left. Circumference of right knee is 3.5 cm. greater than left leg. X-ray : over-growth of femoral and tibial epiphyses. 13.6.1977 : synovectomy.

#### Case No. 4

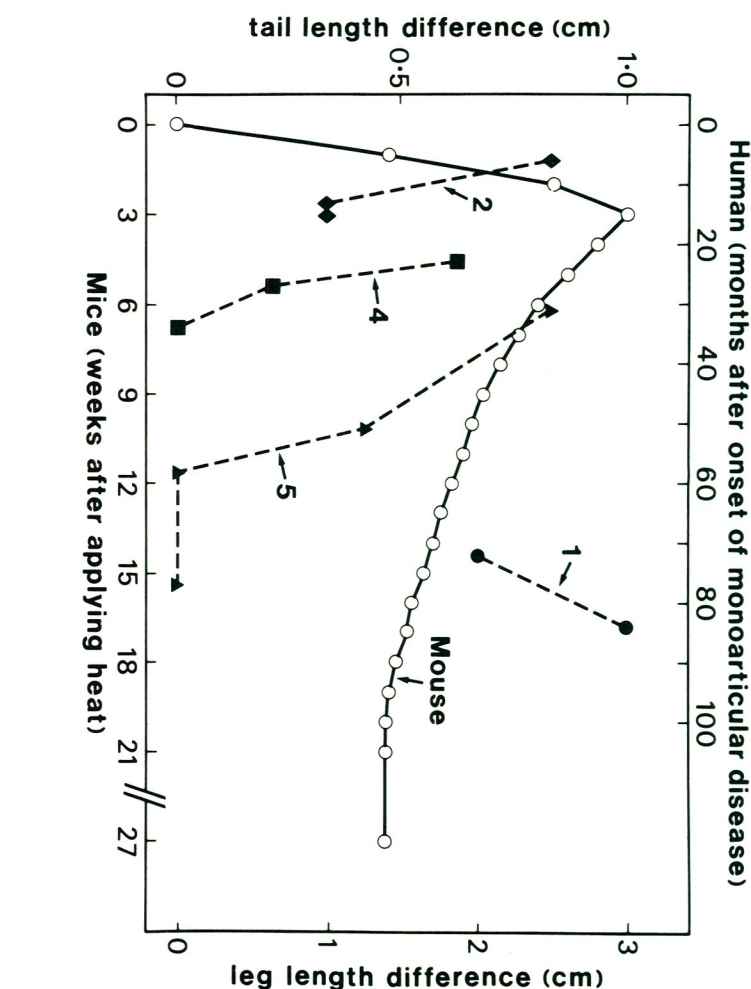
J.H. (M.), born 16.3.1958 : October 1966 : onset of monoarticular rheumatoid arthritis of left knee. 10.9.1968 : left leg 3/4 inch (18.75 mm) longer than right. Circumference of right leg 1 inch (2.5 cm.) greater than right. X-ray : over-growth of femoral and tibial epiphyses. Synovectomy. 6.1.1969 : left leg is 1/4 inch (6.25 mm) longer than right. 4.8.1969 : leg lengths equal. At 5 years of follow up : epiphyses are equal.

#### Case No. 5

J.D., born 26.9.1964 : 1968 : at the age of 3 years 1 month : onset of monoarticular rheumatoid arthritis of right knee. 20.5.1972 : right leg 1 inch (2.5 cm.) longer than left. Circumference of right knee 1 inch (2.5 cm.) longer. X-ray : over-growth of femoral and tibial epiphyses. 4.1.1973 : right leg 1/2 inch (1.25 cm.) longer than left. 8.8.1974 : leg lengths equal. 25.3.1976 : leg lengths equal.

## RESULTS

It has been shown that the tail bones of mice maintained in a hot environment of 33°C grow faster and longer than those kept in an environmental temperature of 21°C (1). The tail of the mouse is a thermoregulatory organ and its temperature closely follows that of the environment particularly distally (2). The main difference in tail length between the 33°C and 21°C groups occurred during the first 3 - 4 weeks following the change of temperature (see figure). In the long term the bones of the mice



Graphical representation of the increased length of human affected over normal limbs (Case No. 1, 2, 4 and 5) and the increased length of heated mouse vertebrae (33°C) compared to controls (21°C).

kept at 21°C completed their normal growth after nearly a year and were found finally to approximate to the length of the 33°C tail bones which completed their normal growth in less than 6 months.

## DISCUSSION

Limb inequality in unilateral articular diseases has been described by many authors and in many anatomical sites. Lengthening of the affected limb has been recorded following rheumatoid arthritis (3, 16), haemangiomas, cirroid aneurysm, venous stasis, arteriovenous fistula, arterial and venous hyperaemia (5, 7, 8, 10, 11, 12, 13, 14, 15, 18, 19, 23, 24). On the other hand, shortening of the

affected part was found in anterior poliomyelitis (20), Osteomyelitis (11, 23), tuberculosis (9, 21), avascular necrosis and delayed healing of fractures (18).

In the clinical cases described in this paper, there was unilateral inflammatory involvement of one knee joint with subsequent lengthening of the affected limb. Thus one must postulate a local accelerating factor due to the adjacent diseased joint. This may be increased vascularity resulting from the inflammatory condition which in turn produces a local raise in temperature over the affected joint and adjacent epiphyses (1, 18). Therefore, these clinical conditions of "hot joints" resemble the

experimental conditions of "hot tail bones".

After a certain period, the short (sound) limb apparently catches up with the length of the diseased side. This catch up has often been attributed to compensatory growth of the growth plate of the healthy limb (6, 23). This seems unlikely because limb overgrowth occurs mainly in the affected bone (6). The growth rate of the sound limb which corresponds to the tail bones of the 21°C mice was maintained over a long period and finally nearly caught up with the length of the diseased limb (the "hot tails") which had stopped growth earlier than the sound limb. In this way, the final results were brought about by changes in both the growth rate and the growth period (1).

The monoarticular "hot joints" reported here occurred during the growing period before epiphyseal fusion. Therefore, the early recognition and diagnosis of the cause of limb inequality is important from the view of orthopaedic management since the prognosis is good and complete recovery and almost equalization is to be expected with time.

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