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Bone and joint changes in lower limb amputees

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SUMMARY A clinical and radiological survery of bone and joint changes in 42 lower limb amputees is reported. There was a significant increase in osteoarthrosis in the knee of the unamputated legs compared with the amputated side. The amputated side characteristically showed osteoporosis. Comparing the prevalence of osteoarthrosis in this study with figures in the population, it is more likely that the osteoporosis of the amputated limb had a protective effect on that side than that mechanical factors produced more osteoarthrosis on the contralateral side. Backache occurred in about half the patients, and was severe in 19%. It did not appear to be related to disc degeneration, but scoliosis was observed in 64% of patients.

As part of an extensive investigation into clinical and biomechanical aspects of osteoarthrosis, groups of subjects who might be especially at risk have been studied at Leeds. These include professional soccer players (Adams, 1976), sports and ex-military parachutists (Murray-Leslie *et al.*, 1977), pneumatic drillers (Burke *et al.*, 1977), and physical education teachers (C. J. Eastmond, C. Hudson and V. Wright, unpublished data). Another group who might be expected to develop changes due to disordered biomechanics are patients with a limb amputated who have been fitted with a prosthesis. We report here the results of a survey carried out in a group of lower limb amputees, attending the Chapel Allerton Artificial Limb and Appliance Centre.

Method

Forty-two unselected single-leg amputees (38 men, 4 women) took part in the study. All were under the age of 65 and had worn a prosthesis for at least 5 years. Inquiry was made into the reasons for amputation, level of amputation, history of other injuries to the legs, and presence of rheumatic symptoms. In the examination a detailed evaluation was made of the legs and lumbar spine, noting swelling, tenderness, limitation of movement, and in the lumbar spine, scoliosis.

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X-rays were taken of the lumbar spine (anteroposterior and lateral), pelvis, and knee(s). They were graded for osteoarthrosis by two observers (M.J.B. and V.W.), using standard criteria (Jeffrey *et al.*, 1963), nil 0, doubtful 1, mild 2, moderate 3, severe 4. Osteoporosis, scoliosis, and other bony changes were noted.

Results

The amputees' mean age was 48·4 years (range 27–64 years) with an average duration from the time of amputation of 24·6 years (range 7–51 years). Their mean weight was 70·3 kg. Amputation had been performed for trauma in 34 subjects, osteomyelitis in 5, and tumour in 3. None had a history of injury to the intact leg. The level of amputation was above the knee in 19, below the knee in 22, and through hip in one.

SYMPTOMS

None of the below-knee amputees had symptoms from the knee of the amputated leg. 22 of the 42 amputees had symptoms from the unaffected opposite knee, considered minimal in 7, mild in 8, and of moderate severity in 7. 3 amputees had minimal symptoms in the hip on the amputated side, while 7 had symptoms in the opposite hip, minimal in 5, mild in 2 and moderate in 3. Backache occurred in 20 amputees being of moderate or severe intensity in 8.

PHYSICAL SIGNS

Minor limitation of hip movement was present in 5 amputees; in 2 of these it was bilateral. The hip of

the amputated leg alone was limited in 2 and the ipsilateral hip in one. In the knee of the unaffected leg crepitus on movement was present in 11 subjects. One knee effusion was noted. 2 amputees had flexion deformities (of 15° and 20° in the knee). Scoliosis was found in 27 amputees.

RADIOLOGY

The radiological gradings for osteoarthrosis are given in the Table. None of the amputees had grade 4 osteoarthrosis in the hips or knee. 7 amputees (16·7% of the total) had radiological evidence of osteoarthrosis (grade 2 or 3) in the knee of the unamputated leg, while none of the other below-knee amputees had osteoarthrosis in that knee. The difference is probably significant ($P<0·05$). There was a slight but not significant increase in osteoarthrosis in the hip of the unamputated leg compared with the hip on the amputated side. The mean age of patients with osteoarthrosis in the knees was 56·5 years (range 53–63 years), with osteoarthrosis of the hip 44·6 years (range 37–57), and with osteoarthrosis of either hip or knee 49·7 years. Osteoporosis in the amputated limb was common, being noted in 37 amputees (88%). It was marked in 5 cases where there was hemiatrophy of the pelvis.

Scoliosis was noted on *x*-ray in 18 amputees (42·9%). Degenerative changes were present in the lumbar spine in 32 amputees (76%). The detailed changes were: at D12/L1 1 had grade 2, 3 had grade 3; at L1/2 7 had grade 2, 2 grade 3; at L2/3 9 had grade 2, 1 grade 3; at L3/4 9 had grade 2; at L4/5 6 had grade 2, 1 grade 4; at L5/S1 2 had grade 2, 1 grade 3, 3 grade 4.

Other changes found were occult spina bifida in 3 and abnormal sacroiliac joints in 2 cases. One had bilateral sacroiliitis and the other patient who had a right below-knee amputation showed sclerosis of the left sacroiliac joint.

Discussion

Our findings are in keeping with those of Hungerford and Cockin (1974) who in a survey of 63 below-knee and 54 above-knee World War II single-leg amputees found a significant increase in tibiofemoral osteoarthrosis on the unamputated side. Osteoporosis was present on the amputated side. They also found a marked increase in patellofemoral osteoarthrosis in the unamputated leg, but this was not apparent in our study.

Table *Radiological grading for osteoarthrosis*

	Grade			
	1	*2*	*3*	*Total grades 2 and 3*
Knee				
Amputated side	5	0	0	0/22
Unamputated leg	4	6	1	7/42
Patellofemoral				
Amputated side	0	0	0	0/22
Unamputated leg	3	0	1	1/42
Hip				
Amputated leg	2	2	0	2/41
Unamputated leg	3	3	2	5/42

Analysis of above-knee amputee gait (Eberhart *et al.*, 1954) using force-plate records has shown that the unamputated leg carries more load than the prosthetic leg. Moreover, the time spent on the artificial leg is markedly less than that spent on the natural leg. This was the explanation Borgmann (1959) gave for the development of osteoarthrosis in the hips and knees of amputees. Inequality of leg length may also contribute to increased stress on the intact leg (Dixon and Campbell-Smith, 1969); to facilitate the forward swing phase in walking the prosthetic leg is made slightly shorter than the unamputated leg.

These factors, all of a mechanical nature, could be the cause of an increased prevalence of osteoarthrosis. However, it should be noted that none of the changes were severe, and indeed the majority were mild. In other groups, notably professional soccer players and pneumatic drillers, we noted 'osteophytic' changes, that would often be interpreted as osteoarthrosis, without joint-space narrowing. We have suggested that these are not really the changes of osteoarthrosis but the reaction to stress in ligaments and tendons adjacent to the joint.

The characteristic osteoporosis seen in the amputated limb almost certainly represents a form of disuse artrophy. It may well have a protective effect, accounting for the lower prevalence of osteoarthrosis in the joints of the amputated limb. Comparison of our figures with data from a similar age group in the population (Lawrence, 1969) suggests that this is the more likely explanation. It is in keeping with the findings of Glyn *et al.* (1966) of a low prevalence of osteoarthrosis in hip and knee in a late review of patients with anterior poliomyelitis.These authors attributed the decreased prevalence to fewer mechanical stresses, but it could equally have been due to the better shock absorption by osteoporotic bone, as suggested by Radin (1976).

Backache was frequent and occurred more commonly than in the general population (Lawrence and Aitken-Swan, 1952). However, disc degeneration was no more frequent (Lawrence, 1969). The presence of scoliosis in 64% of the amputees suggests that mechanical factors consequent on the amputation may be responsible for the back symptoms.

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