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Occupationally related ultrasonic findings in carpet and floor layers' knees

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KIVIMÄKI J. Occupationally related ultrasonic findings in carpet and floor layers' knees. *Scand J Work Environ Health* 1992;18:400-2. Soft-tissue changes in the anterior aspect of the knees were evaluated with ultrasonography among 96 randomly selected carpet and floor layers and 72 painters. The ultrasonography showed thickening of the prepatellar or superficial infrapatellar bursa in 49% of the carpet and floor layers and 7% of the house painters. Fluid collection in the prepatellar or superficial infrapatellar bursa was noted for 10 carpet and floor layers, and this ultrasonographic finding was associated with knee pain in kneeling postures.

Key terms: prepatellar bursitis, beat knee, kneeling work.

Knee pain is common among workers who frequently kneel in their jobs (1). Soft-tissue lesions in the anterior aspect of the knee have been the most typical changes found among kneeling workers (2). "Beat knee," consisting of bursitis or subcutaneous cellulitis in the knee, is classified as an occupational disease among kneeling workers (3-4).

The objective of this study was to assess the effect of kneeling work on soft-tissue changes in the anterior aspect of the knee. I also wanted to study the relation between bursal changes and knee symptoms. For these purposes workers from two occupations, carpet and floor layers, who are known to kneel frequently in their work, and house painters, who seldom adopt kneeling postures, were studied. Their knee condition was evaluated with the aid of a questionnaire, a physical examination of the knees, and an ultrasonographic evaluation of soft tissues in the anterior aspect of the knees.

Subjects and methods

All actively working carpet and floor layers who were aged 25-49 years, lived in southern Finland, had at least five years' experience in their current occupation, and were registered members of the trade union were enlisted into the study. The house painters were selected with the same criteria and with the use of frequency matching according to five-year age strata. One hundred and sixty-eight (78%) of 216 carpet and floor layers and 146 (66%) of 221 house painters participated in the study. Ninety-six carpet and floor layers and 72 painters were randomly selected for an ultrasonic examination of the knees. In this study I included the subjects that had been examined with the ultrasonography. All of the subjects were men.

In a self-administered questionnaire the subjects were asked to indicate the number of years in their current occupation and their average worktime per week. Their lifetime knee morbidity was evaluated from questions on knee disorders confirmed by a physician, knee accidents treated by a physician, sudden and intense swelling of the knee, and medical measures directed towards the knees.

Pain in the right and left knees separately during the preceding month was asked for the following situations: ascending stairs, descending stairs, walking on level ground, sitting still, resting at night, squatting, and kneeling. For further data analysis, a dichotomous knee-pain index was formed based on the first five tasks (0 = no pain in any of the tasks, 1 = pain in one or several tasks). Pain during squatting and kneeling was excluded from this categorization because of the differences in the occurrence of the postures in the two occupations in question.

The subjects indicated the intensity of their knee pain in the right and left knees during the preceding month on a 5-cm long visual analogue scale ranging from "no pain" to "worst possible pain" according to Million et al (5). The ratings were approximated to the nearest centimeter.

Eleven randomly selected floor layers, fifteen carpet layers, and nine painters were videotaped performing typical work tasks. The total observation time was 12 h. In the analysis of the tapes, the proportions of work postures with one knee or both knees on the floor were calculated.

The clinical examination was carried out by a specialist in physical medicine, who was unaware of the previous knee disorders or actual knee symptoms of the subjects. Skin changes in the area of the anterior aspect of the knee were recorded, and the soft tissues around the knee were examined with detailed palpation. The examiner was officially blinded with regard to the subject's occupation, but in many cases the skin changes of the knees revealed the occupation.

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The ultrasonic examination was performed by a specialist in radiology, who was unaware of each subject's occupation, the medical history of knee disorders, and actual knee symptoms. Soft tissues in the anterior aspect of the knee were examined with a real-time sonographic machine, Toshiba SAL—38 D, with a 7.0 MHz linear array transducer. The stand-off pad was replaced with a water cell that was coupled to the transducer. Mineral oil was used to attain appropriate acoustic coupling of the water cell to the skin.

Changes in the prepatellar bursa, quadriceps tendon, deep infrapatellar bursa, superficial infrapatellar bursa, and patellar tendon were registered. The thickness of the patellar tendon at its horizontal midline was measured from the longitudinal sonogram with the transducer on the ventral side of the tendon.

The chi-square test was used for the statistical testing of contingency tables.

Results

The average worktime in the current occupation was 15.1 (SD 8.3) years for the carpet and floor layers and 17.8 (SD 8.2) years for the painters. The average weekly worktime was 40 h for both occupations. Among the carpet and floor layers the proportion of kneeling work postures was 42%, while among the painters it was only 3%.

Twenty-six percent of the carpet and floor layers and 43% of the painters ($P < 0.05$) did not report pain in any of the seven situations inquired about. Knee pain in a kneeling posture was reported by 65% of the carpet and floor layers and 44% of the painters ($P < 0.001$). According to the knee pain index 33% of the carpet and floor layers and 34% of the painters had pain in their knees.

Sudden and intense swelling of the knee was reported by 57% of the carpet and floor layers and 26% of the painters ($P < 0.001$). Forty-eight percent of the carpet and floor layers and 30% of the painters reported a knee accident that had been treated by a physician ($P < 0.001$).

Verified bursitis in front of the knee cap was reported by 39% of the carpet and floor layers and by 11% of the painters ($P < 0.001$). Meniscal injuries were reported by 18 and 14% and knee ligament injuries by 13 and 8% of the subjects, respectively. The differences between the occupations were not significant for meniscal injuries and ligament injuries, possibly because of the lower frequency of these injuries.

The carpet and floor layers reported injections to the knees and knee tapping more frequently than the painters, but the differences between occupations in reported arthrographies, arthroscopies, or meniscectomies were not significant (table 1).

Callous-formed soft-tissue thickening and erythema in the anterior aspect of the knee were the most common clinical findings among the carpet and floor layers (table 2). Soft-tissue tenderness in front of the patella

or patellar tendon was seldom noted in either occupation. The occurrence of these clinical findings was not related to age.

The ultrasonic examination revealed changes in the prepatellar or superficial infrapatellar bursa among 49% of the carpet and floor layers and 7% of the painters (table 3). Eighteen percent of the subjects, all of them carpet and floor layers, had some bursal change in both knees. Thickness of the bursal walls was not measured, but the occurrence of bursal thick-

Table 1. Knee treatments reported by the carpet and floor layers (N = 96) and the painters (N = 72) during their life-times.

Treatment	Carpet and floor layers (N)	Painters (N)	P-value
Knee tapping	41	14	<0.001
Injection to the knees	22	4	<0.001
Arthroscopy	3	1	
Arthrography	18	10	
Meniscectomy	7	8	

Table 2. Clinical findings in the knees of the carpet and floor layers (N = 96) and the painters (N = 72) according to the percentage of knees.

Finding	Carpet and floor layers' knees (N 192) (%)	Painters' knees (N 144) (%)	P-value
Skin thickening in the anterior aspect of the knee	54	6	<0.001
Erythema in the anterior aspect of the knee	21	1	<0.001
Soft tissue thickenings around the patellar tendon	49	7	<0.001
Tenderness of soft tissues in front of the patella	1	0	
Tenderness in front of the patellar tendon	6	0	<0.05

Table 3. Findings in the ultrasonic examination of the anterior aspect of the knees of the carpet and floor layers (N = 96) and the painters (N = 72).

Finding	Carpet and floor layers (N)	Painters (N)	P-value
Thickening of the prepatellar bursa	45	2	<0.001
Thickening of the superficial infrapatellar bursa	35	4	<0.001
Fluid collection in the prepatellar bursa	1	—	
Fluid collection in the superficial infrapatellar bursa	10	—	<0.001
Changes in the quadriceps tendon	—	1	
Changes in the patellar tendon	2	3	

ening was not related to the number of work years in a kneeling occupation.

Collection of hypoechoic fluid in the prepatellar or superficial infrapatellar bursa was verified for 8% of the carpet and floor layers but for none of the painters. The ultrasonographic bursal changes were not related to age, reported knee bursitis, or clinical findings of the knee. The average thickness of the patellar tendon was 4 mm in both groups.

The carpet and floor layers reported pain in kneeling postures for all of the knees with intrabursal fluid collections and for 47% of the other knees ($P < 0.001$). The knee-pain index, the ratings from the visual analogue scale, and soft-tissue tenderness in the anterior aspect of the knee were not related to intrabursal fluid collection.

Discussion

This cross-sectional, epidemiologic study revealed soft-tissue changes in the anterior aspect of the knee several times more often among carpet and floor layers than among painters. The ultrasonography revealed diffuse thickening in the prepatellar or superficial infrapatellar bursa in half of the carpet and floor layers. The ultrasonographic finding was related to knee pain for 8% of the carpet and floor layers who had signs of acute bursitis in the anterior aspect of the knee.

The carpet and floor layers participated more actively in the examinations than did the painters. The subjects with a high knee load or knee symptoms were obviously more interested in having their knees examined. About one-half of the subjects that had not accepted the invitation to be examined could be contacted, and most of them reported that they had no knee symptoms. All of the examined subjects were actively working, and therefore the workers with the most disabling knee disorders were excluded from the study.

In accordance with previous studies, soft-tissue changes in the anterior aspect of the knee were a typical finding among the carpet and floor layers, who predominantly use a kneeling posture in their job (2–4). A work analysis of carpet and floor laying and painting work revealed that Finnish carpet and floor layers kneeled over 40% of the total observation time in some of their typical tasks, whereas painters only occasionally kneeled in their work (6). Almost all of the carpet and floor layers used protective knee pads in their work, but the use of these pads did not prevent bursal changes.

Although the skin changes on the carpet and floor layers' knees sometimes looked very imposing, they were not related to occupational knee pain. Skin thick-

ening apparently impaired the reliability of the clinical examination in detecting bursal lesions.

In recent years the ultrasonic examination has been used to help diagnose a wide variety of knee disorders (7). Ultrasonography has been proved more reliable than computerized tomography in detecting lesions in the patellar tendon (8). In this study the repeatability of the ultrasonic examination to detect tendinous and bursal changes was not tested.

Bursal thickening is probably not a residual lesion after acute bursitis because no relation between ultrasonic findings and reported previous knee bursitis was noted. Conversely, bursal thickening may be caused by chronic irritation that, in kneeling postures, is directed to the anterior aspect of the knee.

The diagnosis "prepatellar bursitis" or "beat knee" has generally been made on the basis of history and clinical findings (9). The results of this study indicate that, among frequently kneeling workers, the clinical examination does not reliably distinguish bursal thickening and bursal effusions. Ultrasonography of kneeling workers' knees can be used for revealing soft-tissue changes, for searching for supportive evidence of occupational injury, and for evaluating the treatment of acute knee bursitis.

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