Osteochondromas, or exostoses, are developmental abnormalities of the growth plate and are known as common benign bone tumors. Although vascular complications of osteochondromas are rare, 39 cases of pseudoaneurysms of the popliteal artery have been reported in the English language literature. These pseudoaneurysms are believed to result as a consequence of an arterial injury due to the exostoses. However, the precise pathogenesis during their development is still unknown because these malformations are undetected as long as they are asymptomatic. In 1967, Heilman et al. described changes in the radiographic appearance of osteochondromas that are pathognomonic for the development of pseudoaneurysms. The purpose of this study was to analyze the changes in the radiographic appearance of an osteochondroma over a 3-month period during pseudoaneurysm development in an effort to delineate the pathogenesis.

CASE REPORT

A 13-year-old boy with a solitary exostosis of the left femur was seen with a pseudoaneurysm of the popliteal artery. When left leg pain occurred 3 months earlier, radiographic examination revealed an exostosis with a cartilage cap. Serial radiographic examination demonstrated gradual disruption of the cartilage cap of the exostosis as the pseudoaneurysm developed. An exostosis with an irregular surface was found at surgery. A literature review disclosed 39 similar cases in which loss of the cartilage cap was considered as one of the causes of the aneurysm formation. Considering the clinical course of our patient, however, we believe that exostoses lose their cartilage caps by pressure destruction due to the aneurysms. It is highly probable that loss of the cartilage does not cause the aneurysms. (J Vasc Surg 2000;32:201-4.)
removed, and the remaining bone edges were smoothed. Histologically, the resected exostosis was composed of bone with no remnant cartilage.

The postoperative course was uneventful, and the patient returned to his normal activity. The patient enjoys a normal high school life 3 years after surgery, with no limitations on his physical activity.

DISCUSSION

Osteochondromas develop during adolescence and occur most commonly at the distal femoral metaphysis. The adjacent popliteal artery is fixed proximally at Hunter's canal and distally at the trifurcation. Thus, both the proximal and distal portions of the popliteal artery have little mobility and can be displaced and stretched over an adjacent osteochondroma. Therefore, pseudoaneurysms due to an osteochondroma tend to occur in the popliteal region.

Of the 39 previously reported patients, 35 patients had an exostosis originating from the distal femur, three had an exostosis originating from the tibia, and one had an exostosis originating from the fibula. Multiple exostoses were found in 13 patients. A family history of exostosis was noted in nine patients. There were 32 men and seven women. The median age was 17 years (range, 9-58 years). In 23 cases (59%), the pseudoaneurysm occurred in the second decade of life. The most likely explanation for the occurrence in this specific age group is the ossification of the cartilage cap. During the growth period, osteochondromas are covered with a soft and pliable cartilage cap that protects the adjacent artery. When growth ceases, the cap ossifies and becomes firm and rigid. The constant rubbing against the ossified exostosis during movement can cause continuous damage to the fixed wall of the artery, eventually leading to rupture. At the time of the onset of symptoms, five of the reported patients had experienced blunt trauma, twelve had engaged in vigorous exercise, and twelve reported no antecedent accidents. In 10 patients, the history was incomplete. Antecedent accidents may cause the final damage, which results in perforation of the artery after repetitive minor trauma due to rubbing on the exostosis.

In our patient, the exostosis was intact, and a cartilage cap was seen on a radiograph at the time the symptom began. However, this changed during the course of the disease. The cap broke, and the cartilage was lost. The change in the radiographic appearance of the exostosis was associated with an exacerbation of symptoms. There was no history of trauma that might have caused a fracture of the exostosis. Therefore, this change is believed to have been due to pressure necrosis of the exostosis induced by the enlarging pseudoaneurysm. Similar destruction of an exostosis by a pseudoaneurysm has been described by other authors. The mechanism of this bony destruction is likely the same as that observed in chronic-contained rupture.
of an abdominal aortic aneurysm in which a pseudoaneurysm develops in contact with the lumbar spine, sometimes causing pressure necrosis of the vertebral body.38

Some authors have suggested that the lack of a cartilage cap causes the aneurysm formation,4,10,11,14,16,21,25,27,34 They have proposed that the sharp bony surface tears the artery after loss of the soft cartilage cover. Of the 39 exostoses complicated by a popliteal pseudoaneurysm, histologic examination revealed no cartilage in 14 cases and only bits of cartilage in 17 cases. In eight cases, no histologic findings were reported. Some authors have reported that the loss of cartilage was due to the maturity of the osteochondroma. They assumed this was the cause of the arterial break down.16,27,34 However, it is difficult to believe that osteochondromas are completely replaced by bone in the second decade without any vestiges of cartilage or ossified cartilage. Other authors have reported that fracture of or trauma to an exostosis can cause loss of the cartilage, resulting in a bone spike or irregular bone surface, which can perforate the vessel.4,10,14,21,25 In patients with an exostosis on a long stalk, fracture can occur, which causes pain.29 However, documented evidence of fracture of an exostosis is rare in patients with a pseudoaneurysm. We believe that these authors may have mistaken pressure necrosis by the pseudoaneurysm for fracture of the exostosis. Most changes in the shape of the exostosis can be attributed to destruction of the bone after formation of the pseudoaneurysm. These changes may occur before the aneurysm becomes large enough to be a pulsatile mass. In such instances, the correct diagnosis is unlikely to be made, as in the present case.

For the diagnosis to be established, CT or magnetic resonance imaging is essential. Three-dimensional CT may be helpful to define the relationship between the exostosis and the aneurysm or artery. Arteriography alone may result in misdiagnosis and is unnecessary in most cases.30 Among the 39 reported cases, primary suture of the artery was possible in 19 cases, vein patch angioplasty was performed in six cases, resection with end-to-end anastomosis was necessary in five cases, and vein grafting was carried out in four cases. Interposition polytetrafluoroethylene grafting and allograft were performed in one case each. Ligation of the artery was reported in one early case. The method used to reconstruct the popliteal artery was not reported in two cases. Although the long-term results were not reported, all 39 patients had a satisfactory postoperative course.

REFERENCES

22. Shah PJ. Aneurysm of the popliteal artery secondary to trau-


Submitted Sep 2, 1999; accepted Dec 6, 1999.