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Giant Solitary Osteochondroma of the D4 Spinous Process in an Adolescent Managed by Multilevel En Bloc Posterior Element Resection: A Case Report

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Abstract

Osteochondroma is the most common benign bone tumor; however, a solitary osteochondroma of a thoracic spinous process is rare, and a giant lesion in an adolescent can resemble an aggressive posterior spinal tumor. We report the case of a 17-year-old boy who presented with a four-month history of a painless, slowly enlarging swelling in the middle of the upper back. Examination showed a hard, fixed, nontender mass at the D4 level, with splaying of the transverse process and no neurological deficit. Computed tomography (CT) of the thorax showed an irregular bony outgrowth measuring 3.8 × 5.6 × 4.9 cm and arising from the D4 spinous process, with no lung or mediastinal disease. Magnetic resonance imaging (MRI) showed a bony mass measuring 4.0 × 5.9 × 5.4 cm and arising from the D4 posterior elements, with a thin cartilage cap and no extension into the spinal canal. Surgery was performed through a posterior midline approach with the patient in the prone position. A 6 × 7 cm exostosis at the D3-D4 interspinous region was removed in one piece, together with part of the D2 spinous process and the entire D3 and D4 spinous processes. Both laminae and the facet joints were left intact, and no implant was needed. The specimen weighed 97 g and measured 6.8 × 7.5 × 6.0 cm. Histopathology confirmed a benign osteochondroma with a cartilage cap measuring approximately 1.5 cm on gross bisection and 0.8 cm on microscopy, with orderly endochondral ossification, a cancellous core, and no atypia. Recovery was uneventful (Clavien-Dindo grade 0); the drain was removed on the sixth day after surgery, and the patient was discharged home in good condition. Multilevel en bloc resection of the posterior elements achieved complete excision without instability or nerve injury. Measuring the cartilage cap on the cut specimen during surgery is a simple and useful step that guides the pathologist in assessing the possibility of malignant change.

Categories: Oncology, Pediatric Surgery, Orthopedics
Keywords: adolescent, cartilage cap, en bloc excision, osteochondroma, posterior element tumour, spinous process, thoracic spine

Introduction

Osteochondroma is the most common benign bone tumor and accounts for 20%-50% of benign bone tumors and 10%-15% of all bone tumors across all ages [1]. Most lesions appear in children and adolescents as painless, slowly growing masses in the metaphyseal region of the long bones [2]. The spine is involved in only 1%-4% of osteochondromas, and about half of spinal lesions arise in the cervical region [3]. In a review of more than 130 spinal cases, the mean age at presentation was 30 years for solitary lesions and about 22 years for lesions in patients with multiple osteochondromas [3]. The posterior elements, meaning the spinous processes, laminae, and transverse processes, are involved more often than the vertebral body because these structures carry the cartilage growth centers from which the lesion arises during skeletal development [3].

Osteochondromas of the thoracic spinous process present distinct diagnostic and surgical challenges. Because the lesion grows posteriorly, away from the spinal canal, and displaces rather than invades the paraspinal musculature, neurological compromise from a spinous process lesion is uncommon even when the mass is large, so a patient can present late with a bulky mass. In a young patient, a posterior thoracic mass has a wide differential that includes Ewing sarcoma, osteosarcoma, aneurysmal bone cyst, and chondrosarcoma, and the diagnosis rests on the age of the patient and on the location and pattern of the lesion on computed tomography and magnetic resonance imaging (MRI) [4]. Serious spinal and paraspinal tumors can be mistaken for a musculoskeletal complaint, as with a sacral chordoma first treated as mechanical lumbar and gluteal pain until imaging [5] and a desmoid tumor of the rhomboid muscle first diagnosed as myofascial pain syndrome until MRI and biopsy [6]. Biopsy is not needed for every radiologically typical osteochondroma, but it is reasonable when the size, an irregular outline, or the age of the patient leaves a sarcoma in the differential.

Complications of osteochondroma include deformity, fracture, vascular compromise, neurological sequelae, bursa formation, and malignant transformation [1], and surgical excision is the treatment of choice except

when the skeleton is still immature [2]. In a review of spinal solitary osteochondromas, neurological deficit regressed after decompression in 81% of patients with cord compromise, and local recurrence and malignant transformation were reported in 4% and 2.7% of 150 cases, respectively [7]. At a posterior spinal site, the main surgical risks are injury to the dura or neural elements, loss of stability when stabilizing structures are removed, and recurrence when the cartilage cap or perichondrium is left behind.

No agreed size threshold defines a giant osteochondroma. The term has been applied to a 6 × 8 cm cervical lesion in an adolescent [8], and a thoracic lesion of 5.9 × 5.0 × 5.4 cm has been described as large [9], so we use it descriptively for a lesion of this order. When such a lesion involves more than one spinal level, the resection has to balance complete en bloc removal against preservation of the laminae, facet joints, and ligaments that keep the spine stable, and nearness to the dura adds to the need for careful planning.

We describe a giant solitary osteochondroma of the D4 spinous process in a 17-year-old boy that measured 6 × 7 cm at surgery. It was removed en bloc together with part of the D2 spinous process and the whole of the D3 and D4 spinous processes, and we correlated the imaging, operative, and pathological findings, including the thickness of the cartilage cap. The report follows the CARE (CAse REports) guidelines [10].

Case Presentation

A 17-year-old boy presented with a four-month history of a painless swelling over the middle of the upper back, first noticed incidentally by his family and slowly enlarging thereafter. He had no pain, limitation of spinal movement, fever, cough, or change in gait. There was no history of injury, previous similar lesions, or relevant family history. General examination was normal, with no lymph node enlargement or neurological deficit. On local examination, there was a hard, fixed, nontender midline swelling measuring 4 × 3 cm at the D4 level, with normal overlying skin. The examiner also recorded a displaced or splayed D4 transverse process. No other bony swelling was found on examination of the skull and the rest of the spine. His gait was normal, and there was no neurovascular deficit in either leg. Written informed consent for publication was obtained from the boy's parent because he is a minor. Table *1* lists the main clinical, radiological, operative, and pathological features.

Domain	Finding
Age and sex	17 years, male
Presenting complaint	Painless, slowly growing midline upper back swelling for four months
Neurological status	Intact, with no deficits and a normal gait
Clinical sign	Hard, fixed, nontender 4 x 3 cm midline mass at D4; splayed D4 transverse process recorded clinically but not involved on imaging
CT thorax	Ill-defined, irregular bony outgrowth measuring 3.8 x 5.6 x 4.9 cm arising from the D4 spinous process, with muscle displacement and no lung, mediastinal, or pleural disease
MRI	Bony mass measuring 4.0 x 5.9 x 5.4 cm from the D4 spinous process, projecting posteriorly, with a cartilage cap of 2.5-5.5 mm, no canal extension, whole spine screening otherwise normal
Preoperative biopsy	Chondroid lesion in keeping with osteochondroma
Approach and position	Posterior midline approach, prone position, and general anesthesia
Operative size	6 x 7 cm lobulated exostosis at the D3 to D4 interspinous region (surgeon's estimate in situ)
Resection	En bloc, part of D2 and the whole of D3 and D4 spinous processes with the tumor, in one piece, no frozen section
Stability	Both laminae and facet joints preserved, no implant or fusion
Specimen	97 g, 6.8 x 7.5 x 6.0 cm with attached skin and muscle; bony segment, 5.5 x 5.2 x 4 cm; lesion 2 cm from the resection margin
Cartilage cap	0.4-0.8 cm on gross pathological examination and 2.5-5.5 mm on MRI
Gross zones	Cartilage cap, enchondral ossification zone, and cancellous core
Histology	Benign osteochondroma, with no atypia or mitoses, no marrow permeation, and a resected end free of cartilage; close follow-up advised by the pathologist in view of interval growth
Complication	None, Clavien-Dindo grade 0
Discharge	Drain removed on the sixth day, mobilized with a thoracolumbosacral orthosis, and discharged in good condition
Follow-up	Asymptomatic at two months (early outcome), with a healed scar, full spinal movement, and no clinical recurrence; six-monthly clinical review planned

TABLE 1: Main clinical, radiological, operative and pathological features of the present case

CT: Computed tomography; MRI: Magnetic resonance imaging.

Blood tests were normal. Computed tomography (CT) of the thorax showed an ill-defined, irregular bony outgrowth measuring 3.8 × 5.6 × 4.9 cm and arising from the D4 spinous process (Figure *1*, Panels A-D). The adjacent paraspinal muscles were displaced, and CT showed no lung lesion, mediastinal lymphadenopathy, or pleural effusion, providing no evidence of intrathoracic extension. MRI of the dorsolumbar spine with whole-spine screening showed a bony mass measuring 4.0 × 5.9 × 5.4 cm and arising from the D4 spinous process and projecting posteriorly (Figure *1*, Panel E). The mass was continuous with the marrow of the posterior elements and carried a T2-hyperintense cartilage cap measuring 2.5-5.5 mm. It displaced the paraspinal muscles without extending into the spinal canal (Figure *1*, Panel F). The screening sequences showed no other abnormalities in the cervical or lumbar spine. Neither imaging report described involvement of the transverse processes, and the clinical impression of a splayed D4 transverse process is best explained by the lobulated mass extending to both sides of the midline beneath the paraspinal muscles (Figure *1*, Panels B and C). A preoperative biopsy showed a chondroid lesion in keeping with an osteochondroma.

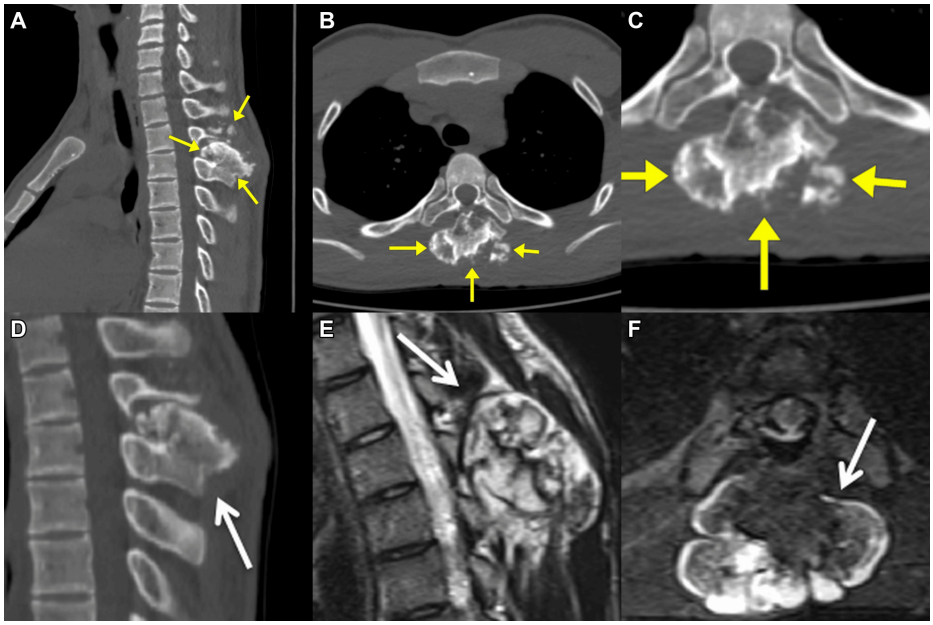


FIGURE 1: Preoperative imaging

(A) Sagittal and (B) axial computed tomography images of the thorax show an irregular bony outgrowth (arrows) arising from the D4 spinous process. (C) Magnified axial and (D) magnified sagittal computed tomography images of the lesion (arrows). (E) Sagittal T2-weighted and (F) axial magnetic resonance images show the mass (arrows) projecting posteriorly, with a thin cartilage cap and no extension into the spinal canal.

After discussion at the tumor board and obtaining a spine surgery opinion before the operation, we removed the lesion en bloc through a posterior midline approach, with the boy in the prone position under general anesthesia. The skin was marked and opened over the D3-D4 region (Figure *2*, Panel A). We divided the thoracolumbar fascia and lifted the paraspinal muscles off the bone around the tumor, which exposed a lobulated bony exostosis measuring 6 × 7 cm at the D3-D4 interspinous region (Figure *2*, Panel B). The muscles were displaced but not invaded, and the dura was intact. The lesion arose from the D4 spinous process and filled the D3-D4 interspinous space, so the D3 spinous process could not be preserved without entering the tumor. Once the margins were defined, we removed part of the D2 spinous process to obtain a margin of normal bone above the lesion, together with the entire D3 and D4 spinous processes. The tumor was removed in one piece along with these structures (Figure *2*, Panel C). We preserved both laminae and the facet joints to maintain stability; therefore, no implant or fusion was needed. After hemostasis, the wound was washed and closed in layers over a suction drain. The intact specimen was sent for routine histopathology, and no intraoperative frozen section was requested because the preoperative biopsy had already shown a benign chondroid lesion.

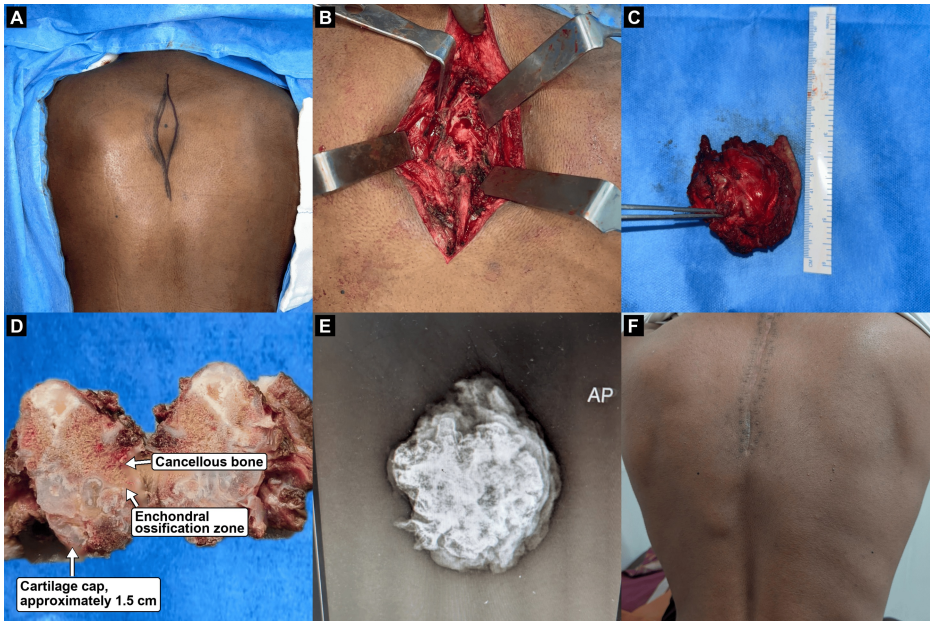


FIGURE 2: Clinical, surgical, and gross pathology sequence

(A) The midline incision marked over the D3-D4 level with the patient in the prone position. (B) Operative exposure of the posterior element exostosis in situ. (C) The en bloc specimen next to a scale. (D) The cut specimen showing the cartilage cap, the enchondral ossification zone, and the cancellous bone. (E) Anteroposterior radiograph of the specimen showing the lobulated, heavily calcified mass. (F) The healed midline scar two months after surgery.

The specimen weighed 97 g and measured 6.8 × 7.5 × 6.0 cm, including attached skin measuring 6.4 × 1.4 cm and muscle measuring 5.5 × 3 cm. The bony segment measured 5.5 × 5.2 × 4 cm, in keeping with the CT and MRI dimensions, whereas the measurement of 6 × 7 cm was the surgeon's estimate of the mass in situ. When cut, the specimen showed a pearly white, glistening, lobulated lesion sitting on the underlying bone, with three clear zones (Figure *2*, Panel D). These were a peripheral cartilage cap, an endochondral ossification zone just beneath it, and a central cancellous core that extended into the bony stalk. The cartilage cap measured 0.4-0.8 cm on gross examination, and the lesion lay 2 cm from the resection margin. A radiograph of the specimen showed the lobulated, heavily calcified mass (Figure *2*, Panel E). Under the microscope, the lesion had a cap of hyaline cartilage overlying bony trabeculae. The cap held bland chondrocytes in lacunae, with no nuclear pleomorphism, hyperchromasia, or increased mitotic activity, and the bone beneath formed well-ordered trabeculae through endochondral ossification. A few small nests of benign cartilage were present between the trabeculae without a permeative pattern, and there was no marrow permeation or cortical destruction. The resected end showed ischemic bone fragments with karyorrhectic debris and no cartilage. The findings were consistent with a benign osteochondroma. In view of the clinical history of interval growth, the pathologist advised close follow-up to exclude an early phase of malignant transformation.

Recovery was smooth, and there were no complications (Clavien-Dindo grade 0) [11]. The drain was removed on the sixth day after surgery, and the boy walked early using a thoracolumbosacral orthosis while mobilizing. He was discharged home in good condition with a clean wound. At the two-month review, he had no symptoms, a healed midline scar (Figure *2*, Panel F), a full range of spinal movement, and a normal neurological examination, with no clinical signs of recurrence. Stability was judged clinically at this early review, and no postoperative imaging was obtained. In line with the pathologist's advice, clinical reviews at six-month intervals were planned, with imaging if new pain, growth, or a palpable change develops.

Discussion

Our patient had a giant osteochondroma of the posterior thoracic spine excised completely, without nerve injury or clinical instability at early follow-up. Three features make the case worth reporting. The lesion was very large; it grew posteriorly and spared the cord; and its removal required a multilevel en bloc resection of the spinous processes. We set each of these features against the published literature.

Spinal osteochondromas make up about 1%-4% of all osteochondromas and tend to involve the posterior elements [3]. They arise on their own or as part of multiple hereditary exostoses (MHE) linked to EXT1 and EXT2 mutations [2]. In our patient, the absence of other exostoses on clinical examination and whole-spine MRI screening, together with the absence of a family history, made MHE unlikely and supports a solitary, sporadic lesion [2]. A whole-body skeletal survey and genetic testing were not performed, so a mild

hereditary form cannot be excluded completely. The boy was 17 years old and close to skeletal maturity, younger than the mean age of 30 years reported for solitary spinal lesions [3], which fits the observation that these lesions grow during the years of rapid skeletal growth.

The painless, slowly growing posterior swelling in our patient is the usual picture of an osteochondroma that grows posteriorly, and the absence of a deficit despite a 6 × 7 cm mass reflects displacement of muscle rather than pressure on the dura. A dorsal scapular osteochondroma in an eight-year-old boy, which presented with mid-back pain, scoliosis, and scapular winging and was managed conservatively, continued to enlarge on follow-up [12]. This illustrates the varied presentation of posterior thoracic osteochondromas and shows that a lesion left in place may continue to grow during skeletal growth. Our patient differs from most symptomatic spinal osteochondromas in the literature, which grow into the canal and present with myelopathy or radiculopathy. Lesions that reach the canal in the thoracic spine have required extracavitary approaches and even partial corpectomy to free the cord [9], and surgical series of intraspinal osteochondromas are dominated by cord or root compression [13,14]. CT and MRI are the key investigations for a suspected spinal tumor [4], and delay in obtaining MRI can postpone the diagnosis [15]. In our patient, the absence of canal extension on MRI allowed a planned elective operation.

The surgical principle is the same as for a long-bone osteochondroma, which is to remove the cartilage cap, the perichondrium over it, and the bony stalk down to normal cortical bone and to avoid piecemeal curettage [3]. Here, the tumor arose from the D4 spinous process, had involved the D3 spinous process, and could not be separated from it, so removing part of D2 and all of D3 and D4 as one block was both an oncological and an anatomical need. The pathology supports this extent because the lesion lay 2 cm from the resection margin and the resected end contained no cartilage. Reported osteochondromas of the thoracic spinous processes have been single-level lesions treated by simple excision [16,17]. In a PubMed search of the English-language literature on October 28, 2026, using the terms osteochondroma or exostosis, spinous process, and thoracic or dorsal in the title or abstract, the seven records retrieved included four human spinous process osteochondromas, all at a single level, and we did not identify a comparable planned multilevel en bloc resection of thoracic spinous processes. The few equally large spinal lesions on record were cervical [8] or caused cord compression [9]. By limiting the resection to the spinous processes, we preserved both laminae and the facet joints and avoided any implant or fusion. Stability was assessed clinically, and its long-term durability remains to be confirmed. A similar canal-sparing removal of the posterior elements with the lamina preserved has been reported for a giant lesion of the axis [18]. Table *2* sets our case beside the reported spinal osteochondromas.

Study (year) [ref]	Design	Age (years) and sex	Level and origin	Size	Neurological deficit	Surgery	Recurrence and outcome
Gille et al., 2005 [7]	Surgical series (6 patients) with literature review	NR	Spinal, solitary	NR	2 of 6 compression	Excision or decompression	No recurrence or malignant change at mean 6 years (5 patients)
Lotfinia et al., 2010 [13]	Surgical series (8 patients)	NR	Cervical, thoracic, lumbar, and intraspinal	NR	All compressive	Posterior, with or without fusion	Satisfactory in 75%
Zaijun et al., 2013 [14]	Surgical series (14 patients)	NR	Mobile spine	NR	Myelopathy or radiculopathy	Resection	Prognosis analyzed
Hu et al., 2016 [16]	Case report (imaging)	NR	Thoracic spinous process	NR	NR	Excision (imaging report)	NR
Silber et al., 2000 [17]	Case report with literature review	Pediatric, NR	T10 spinous process	NR	None	Excision	Definitive, NR
Huda et al., 2014 [8]	Case report	14, female	Lower cervical	6 x 8 cm (giant)	NR	Excision	NR
Tahasildar et al., 2012 [18]	Case report with literature review	5, female	C2 posterior (MHE)	Large	None, canal spared	Excision, lamina preserved	No recurrence at 2 years
Pham et al., 2016 [9]	Case report with literature review	17, male	T9, posterior vertebral body	5.9 x 5.0 x 5.4 cm (giant)	Myelopathy	Extracavitary and partial corpectomy	Full neurological recovery
Present case	Case report	17, male	D4 spinous process	6 x 7 cm in situ (giant), bony segment 5.5 x 5.2 x 4 cm	None	En bloc resection of part of D2 and all of D3 and D4 spinous processes	No clinical recurrence at two months (early outcome)

TABLE 2: Reported solitary spinal osteochondromas and surgical series compared with the present case

NR: Not reported; MHE: Multiple hereditary exostoses.

Cartilage cap thickness is a useful marker of the risk of malignant change. After skeletal maturity, a cap thicker than 1.5 cm suggests malignant transformation [1], whereas a thicker cap can be physiological in a patient who is still growing. Imaging measurements of the cap agree closely with those of the pathological specimen, with a mean error of less than 2 mm [19]. In our patient, the cap measured 2.5-5.5 mm on MRI and 0.4-0.8 cm on gross pathological examination. The small difference between the two is of the order of the reported measurement error and is also likely to reflect the planes of the MRI slices and pathological sections. Both values were well below the threshold; however, as the patient was close to skeletal maturity and the history recorded interval growth, cap thickness was interpreted together with the histology, which showed bland chondrocytes without permeative growth, rather than on its own.

The main long-term concern is a secondary peripheral chondrosarcoma. Malignant change occurs in about 1% of solitary osteochondromas and in 3%-5% of patients with hereditary multiple exostoses [1], and among 150 reported spinal solitary osteochondromas, local recurrence occurred in 4% and malignant transformation in 2.7% [7]. A chondrosarcoma of the mobile spine carries a much worse outlook, and intralesional surgery is followed almost always by local recurrence [20], which shows why a complete first excision matters. Warning signs are new pain, continued growth after skeletal maturity, a cartilage cap thicker than 1.5 cm after skeletal maturity [1], an irregular junction between the cap and bone, and an enhancing soft tissue mass. In this patient, given the benign histology, a resected end free of cartilage, and

the pathologist's request for close follow-up because of the documented interval growth, we elected clinical surveillance at six-month intervals with a low threshold for imaging, acknowledging that no evidence-based surveillance protocol exists for this rare presentation.

The strength of this report is the complete photographic, radiological, and pathological record. Its limitations are those of a single case with no comparison group, a follow-up of two months that shows only an early outcome and cannot establish long-term stability or freedom from recurrence, the absence of postoperative imaging, and the absence of a whole-body skeletal survey or genetic testing.

Conclusions

A giant solitary osteochondroma of a thoracic spinous process is rare. In this adolescent, excision was indicated by a large posterior mass that had grown in size and had an irregular outline on CT. A multilevel en bloc resection of part of the D2 and all of the D3 and D4 spinous processes, with both laminae and the facet joints preserved, was feasible and resulted in complete excision with a favorable early outcome. These findings come from a single patient with two months of follow-up and cannot establish long-term stability or freedom from recurrence; therefore, clinical surveillance continues. Immediate submission of the intact specimen for gross pathological examination, with measurement of the cartilage cap on the cut surface, is a simple quality step. Where malignancy is suspected during surgery, frozen section can guide the extent of resection.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

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Disclosures

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