Adamantinoma-like Ewing Sarcoma in a Metatarsal Bone After Chemotherapy Treated with an Osteocutaneous Fibular Transfer: A Case Report.

Yolandi Anne Marais (ymarais87@sun.ac.za)
Stellenbosch University https://orcid.org/0000-0003-1170-6378
Aaron Saini
Stellenbosch University
Nando Ferreira
Stellenbosch University
Kershinee Reddy
Stellenbosch University
Alexander Zühlke
Stellenbosch University
Nelmarie Rossouw
Stellenbosch University
Stefan Dan Zaharie
Stellenbosch University
Pawel Tomasz Schubert
Stellenbosch University

Case Report

Keywords: Ewing sarcoma, Adamantinoma-like Ewing sarcoma, P40, P63, Squamous differentiation, neo-adjuvant, Osteocutaneous fibular transfer

Posted Date: October 26th, 2020

DOI: https://doi.org/10.21203/rs.3.rs-96041/v1

Abstract

Background: Adamantinoma-like Ewing sarcoma is a rare variant of Ewing sarcoma known to have cytokeratin expression and squamous differentiation. It occurs more commonly in the head and neck region with only a few cases reported in long bones of the limbs. It also harbours EWSR1-FLI1 gene fusion which is required for the diagnosis of Ewing sarcoma. We present a case of Ewing sarcoma that manifested Adamantinoma-like morphology only post chemotherapy. Chemotherapy has been reported to induce neuronal maturation and rhabdoid morphology in cases of Ewing sarcoma, but no reports of treatment induced squamous differentiation with P40/P63 expression have been demonstrated to date.

Case presentation: An 11 year old boy presented with a one year history of an enlarging painless mass over the left first metatarsal. Initial biopsy showed Ewing sarcoma with typical morphological features and EWSR1 rearrangement confirmed on fluorescent in-situ hybridization. The patient underwent neo-adjuvant chemotherapy and a subsequent wide local excision with an ipsilateral pedicled osteocutaneous fibula transfer. Subsequent histological examination showed frank squamous differentiation in the soft tissue component with keratin pearl formation and P40/P63 expression which was not observed in the initial biopsy and is compatible with Adamantinoma-like Ewing sarcoma.

Conclusion: This case describes Adamantinoma-like Ewing sarcoma with P40/P63 expression after neo-adjuvant chemotherapy treatment. This immunophenotype was not apparent on the initial biopsy. It remains uncertain as to the reason for this change. This variant carries a poorer clinical outcome compared to the more conventional variant and could pose a diagnostic challenge(s) particularly if it occurs in an older patient or as a metastatic lesion.

Background

Ewing sarcoma is a small round cell sarcoma typically arising in the diaphyseal and metadiaphyseal regions of long bones, predominantly in children and young adults, but can also be seen in soft tissues (particularly of the trunk). It shows gene fusions involving one member of the EFT family of genes and a member of the ETS family of transcription factors. Up to 85% of cases harbour a t(11;22)(q24;q12) resulting in EWSR1-FLI1 gene fusion and up to 25% of cases express cytokeratins (1–6). Numerous histological variants exist, namely classic, atypical/large cell, sclerosing, spindle cell sarcoma-like and also one that shows squamous differentiation, called Adamantinoma-like Ewing sarcoma. This latter variant, presents more commonly in the head and neck region with only a few cases involving the appendicular skeleton (7–23). Here we present a case with a metatarsal tumour that showed Adamantinoma-like features and P40/P63 expression after neo-adjuvant chemotherapy treatment.

Case Presentation

An eleven-year-old male patient presented with the history of a painless mass involving the first metatarsal of the left foot that was gradually enlarging over the preceding year. Local examination

confirmed a firm, 80 mm by 30 mm mass involving the first metatarsal of the left foot. Ankle range of motion was full and painless. Systemic examination did not reveal any abnormalities and laboratory investigations were unremarkable.

Plain radiographs showed mixed lytic and sclerotic changes involving the entire first metatarsal, with an indistinct permeative appearance of the cortex, associated periosteal reaction and a subtle soft tissue component (Fig. 1). A MRI scan showed a diffuse aggressive destructive process involving the entire first metatarsal, with heterogeneous medullary cavity enhancement, an aggressive periosteal reaction and breach of the cortices. The lesion appeared heterogeneous, hypo- and isointense on T1 weighted images, and heterogeneous hyperintense on T2 weighted images. An associated soft tissue component encased the metatarsal and illustrated post contrast enhancement (Fig. 2A). Systemic staging included an F-18 FDG PET/CT scan that showed several skeletal lesions including to the left humerus, lumbar spine and pelvis. An incisional biopsy confirmed the diagnosis of Ewing sarcoma with EWSR1 rearrangement with FISH.

The patient received emergency radiotherapy prior to commencement of neo adjuvant chemotherapy due to spinal cord compression secondary to skeletal metastases. Post radiotherapy, the Children's Oncology Group Ewing Sarcoma Protocol (AEWS0031) was commenced. Duration of this chemotherapy regimen spans 48 weeks and compromises courses of Vincristine (V) (1.5 mg/m^2/dose), Doxorubicin (D) (75 mg/m^2/dose), Cyclophosphamide (C) (1.2 g/m^2/dose) (VDC) alternating at intervals with courses of Ifosfamide (1.8 g/m2/day for 5 days per course) and Etoposide 100 mg/m^2/day for 5 days per course) (IE). The patient received 5 cycles of neoadjuvant chemotherapy comprising VDC/IE before local and systemic staging was repeated to assess response to the chemotherapy. A repeat MRI scan confirmed the permeative destructive process of the first metatarsal with interval decrease in size of the associated soft tissue component (Fig. 2B). The follow-up PET/CT showed evidence of residual disease in the known primary of the left foot with no evidence of disease elsewhere.

Definitive surgical management consisted of wide excision of the first metatarsal through a dorso-medial approach including resection of the biopsy tract (Fig. 3). Reconstruction of the bone and soft tissue defect was accomplished by an ipsilateral pedicled osteocutaneous fibula flap (Fig. 4). Once all wounds had healed adjuvant chemotherapy, consisting of VDC and IE, was re-commenced and weight-bearing was allowed in a supportive boot. Clinical review at 3 months found a plantigrade sensate foot with no instability of the hallux (Fig. 5). On completion of the chemotherapy regimen, the patient will receive adjuvant radiotherapy for positive surgical margins.

Histology

Initial biopsy:

The pre-treatment biopsy (routinely formalin-fixed, paraffin-embedded, decalcified and haematoxylin-eosin-stained) showed a lesion composed of invasive nests of uniform small round cells with round

nuclei containing finely stippled chromatin and inconspicuous nucleoli, scant clear to eosinophilic cytoplasm and indistinct cytoplasmic membranes (Fig. 6). Immunohistochemical studies showed membranous expression of CD99 and nuclear expression of FLi-1 in the tumour cells. FISH revealed rearrangement of the EWSR1 gene.

Resection specimen:

Macroscopically the specimen consisted of the left first metatarsal with overlying skin and surrounding soft tissue and measured 60 × 50 × 35 mm. On cut section a white-grey lesion was present in the periosteal soft tissue with areas of haemorrhage but could not be seen extending into the bone. Microscopically residual tumour was mostly present in the soft tissue inferior to the metatarsal with scant microscopic foci of residual tumour in the medullary cavity of the metatarsus. Histologically it showed typical features of Ewing sarcoma as seen in the initial biopsy but now with wide-spread squamous differentiation in the form of frank keratin pearl formation and prominent eosinophilic cytoplasm (Fig. 7). Areas of necrosis and stromal fibrosis were observed which related to treatment effect. Immunohistochemical studies showed CD99 and FLi-1 expression as seen in the previous biopsy. Additional immunohistochemical stains were performed on both (pre- and post-chemotherapy) specimens and included: AE1/AE3, CK5, P63 and P40 (Table 1). The AE1/AE3 showed positive staining in both specimens but the P63 and P40 (Fig. 8) were only positive in the resection specimen on both decalcified and non-decalcified tissue. CK5 showed only isolated single cell positivity in the initial biopsy but was diffusely positive in the resection specimen. The resection specimen showed diffuse expression of 34βE12. Desmin and WT1 immunohistochemical stains were negative and ruled out the possibility of a metastatic desmoplastic small round cell tumour that can also express CD99 and cytokeratins.

Table 1
Immunohistochemical staining profile: + (positive), - (negative).

Immunohistochemical stain	Initial biopsy	Resection specimen
CD99	+	+
Fli-1	+	+
P63	-	+
AE1/AE3	+	+
CK5	+	+
P40	-	+

Discussion

In this case report we demonstrate a metatarsal lesion with morphological features in keeping with ‘classic’ Ewing sarcoma, on initial biopsy, with morphological and immunophenotypical changes to an Adamantinoma-like Ewing sarcoma variant post chemotherapy. We considered that this change may be

due to one of the following: 1. Emergence/persistence of a more chemotherapy resistant clone; 2. Under sampling of the tumour on the initial biopsy; or 3. Alterations in the tumour morphology &/or immunophenotype caused by chemotherapy.

Chemotherapy response of Ewing sarcoma is graded according to the Paediatric Oncology Groups Study(24)and these changes typically are present as necrosis, haemorrhage, cystic degeneration, calcification, ossification and fibrosis, though alternative grading systems like that by Huvos *et al.* also exist (25). The grading of chemotherapeutic response has prognostic and therapeutic significance as it plays a role in chemotherapy agent selection for the continuation chemotherapy (24, 26–28). There is also some literature that suggests that the Adamantinoma-like Ewing sarcoma may be associated with a more aggressive clinical behaviour and with poorer outcomes (7).

Other morphological changes in Ewing sarcoma post chemotherapy include: neuronal maturation with rosette formation and gangliocytic phenotype differentiation. Rhabdoid change has also been described though the tumour maintained its immunophenotype (29, 30). Knezevich *et al*. described loss of EWS/FLi-1 gene fusion in the recurrent tumour (31), while Smith *et al*. described a different genetic alteration in one of the tumour nodules (32). No case reports of squamous differentiation (including keratin pearl formation) with P40 expression post chemotherapy could be found on a literature search (33).

Adamantinoma–like Ewing sarcoma shows squamous differentiation, cytokeratin expression and P40/P63 expression which is not seen in classic Ewing sarcoma although 25% of classic Ewing sarcomas do express keratins such as CAM5.2, AE1/AE3 and MNF-116 (3, 4). In our case report the original tumour was P63 & P40 negative and only showed positivity for these two markers in the resection specimen (post neo-adjuvant chemotherapy). CK5 tended to mimic this pattern. FISH testing for EWS fusion was positive on the initial biopsy, but the mating partner remains uncertain.

It would hence appear that this phenotype and immunophenotype was not present initially and only appeared post-chemotherapy. Therefore, raising the following questions: 1. Is this a more chemotherapy resistant clone? 2. Was the initial tumour truly under sampled? 3. Is this a chemotherapy induced change?

Additionally if a pathologist is confronted with a metastatic lesion of such a tumour (particularly in an older patient), in the head and neck region, it may cause diagnostic dilemmas with a number of neoplasms that also show a small cell morphology with squamous differentiation such as basaloid variants of squamous cell carcinoma and NUT-midline carcinoma. Thus, adequate immunohistochemical workup and/or molecular confirmation to establish the diagnosis of Adamantinoma-like Ewing sarcoma is advised (17) .

Apart from the unique histological findings of this case, a novel reconstructive strategy was also employed. Reconstruction of the first metatarsal is more critical than the lesser metatarsals given its role in progression through the gait cycle. In the context of trauma, first ray reconstruction using both free and

pedicled fibula flaps was described as early as 1991(34). Wang *et al.* described a series of four patients who had metatarsal reconstruction, two of the first ray and two of the lesser, using pedicled fibula flaps (35). More recently Hilaire (36) described computer assisted virtual surgical planning in a case of first metatarsal reconstruction using a free fibula flap. Malignancy of the metatarsals, however, has limited options in terms of salvage surgery. Management of primary bone tumours of the lesser metatarsals usually consist of ray (37) or below knee amputation (35, 36). Few reports exist on the use of autologous vascularised fibula grafts, either free or pedicled, for forefoot reconstruction. Borthakur *et al.* described vascularised free fibula transfer post resection of a first ray osteosarcoma (38). Toriyama *et al.* reported concomitant first and second metatarsal reconstruction following resection for chondrosarcoma using a free vascularised double-barrelled fibula graft (39), and Toma *et al.* reported a series of six cases of metatarsal primary bone tumours resected and reconstructed with free vascularised fibula graft, including the first and lesser rays(40). To our knowledge, our case is the first description of a pedicled vascularised fibula graft used for the reconstruction of the first metatarsal post resection for malignancy.

Conclusion

This is the first case to describe squamous differentiation, P63 and P40 expression that appeared in a Ewing sarcoma after administration of chemotherapy. This change from the 'classic' variant to the 'Adamantinoma-like' variant is interesting, and the mechanism of this change is not fully understood especially in light of some literature that suggests that the latter variant of Ewing sarcoma may carry a poorer prognosis. More research on this topic is indeed necessary.

Abbreviations

EWSR1, EWS RNA binding protein 1; FLI1, friend leukaemia integration 1 transcription factor; EFT, Ewing family tumors; ETS, erythroblast transformation specific; MRI, magnetic resonance imaging; FDG, fluordeoxyglucose; PET, positron emission tomography; CT, computed tomography; FISH, fluorescent in situ hybridization; VDC, vincristine doxorubicin cyclophosphamide; IE, ifosfamide etoposide; EWS, Ewing sarcoma; NUT, nuclear protein in testis; H&E, haemotoxylin and eosin.

Declarations

Acknowledgements:

Not applicable.

Funding:

Funding for author publication costs has been received from the Open Access Publication Fund of Stellenbosch University and The Department of Anatomical Pathology of Stellenbosch University.

Availability of data and materials:

The dataset supporting the conclusions of this article is included within the article.

Authors' contributions:

YAM wrote the manuscript. AS, NF, KR, AZ and NR were involved in the treatment of the patient. SDZ, NF and PS revised the manuscript. All authors read and approved the final manuscript.

Competing interests:

The authors declare that they have no competing interests.

Consent for publications:

Written informed consent was obtained from the parent of the patient for publication of this case report and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

Ethics approval and consent to participate:

Ethical approval was obtained from the Stellenbosch University Health Research Ethics Committee – C20/09/030.

References

1. Choi EYK, Gardner JM, Lucas DR, McHugh JB, Patel RM. Ewing sarcoma. Semin Diagn Pathol [Internet]. 2014;31(1):39–47. Available from: http://dx.doi.org/10.1053/j.semdp.2014.01.002
2. WHO Classification of Tumours Editorial Board. WHO Classification of Tumours of Soft Tissue and Bone. 5th ed. Lyon, France: IARC Press; 2020.
3. Elbashier SHA, Nazarina AR, Looi LM. Cytokeratin immunoreactivity in Ewing sarcoma/ primitive neuroectodermal tumour. Malays J Pathol [Internet]. 2013 Dec;35(2):139–45. Available from: http://www.ncbi.nlm.nih.gov/pubmed/24362477
4. Gu M, Antonescu CR, Guiter G, Huvos AG, Ladanyi M, Zakowski MF. Cytokeratin Immunoreactivity in Ewing's Sarcoma. Am J Surg Pathol. 2000;24(3):410–6.
5. Srivastava A, Rosenberg AE, Selig M, Rubin BP, Nielsen GP. Keratin-positive Ewing's sarcoma: An ultrastructural study of 12 cases. Int J Surg Pathol. 2005;13(1):43–50.
6. Kilpatrick SE, Reith JD, Rubin B. Ewing sarcoma and the history of similar and possibly related small round cell tumors: From whence have we come and where are we going? Adv Anat Pathol. 2018;25(5):314–26.
7. Bridge JA, Fidler ME, Neff JR, Degenhardt J, Wang M, Walker C, et al. Adamantinoma-like Ewing's Sarcoma: Genomic Confirmation, Phenotypic Drift. Am J Surg Pathol [Internet]. 1999 Feb;23(2):159–65. Available from: http://journals.lww.com/00000478-199902000-00004

8. Hauben E, van den Broek LCJM, Van Marck E, Hogendoorn PCW. Adamantinoma-like Ewing's sarcoma and Ewing's-like adamantinoma. The t(11; 22), t(21; 22) status. J Pathol [Internet]. 2001 Sep;195(2):218–21. Available from: http://doi.wiley.com/10.1002/path.919
9. Bishop JA. Recently described neoplasms of the sinonasal tract. Semin Diagn Pathol [Internet]. 2016 Mar;33(2):62–70. Available from: http://dx.doi.org/10.1053/j.semdp.2015.12.001
10. Alexiev BA, Tumer Y, Bishop JA. Sinonasal adamantinoma-like Ewing sarcoma: A case report. Pathol Res Pract [Internet]. 2017;213(4):422–6. Available from: http://dx.doi.org/10.1016/j.prp.2016.11.018
11. Lilo MT, Bishop JA, Olson MT, Ali SZ. Adamantinoma-like Ewing sarcoma of the parotid gland: Cytopathologic findings and differential diagnosis. Diagn Cytopathol. 2018;46(3):263–6.
12. Morlote D, Harada S, Lindeman B, Stevens TM. Adamantinoma-Like Ewing Sarcoma of the Thyroid: A Case Report and Review of the Literature. Head Neck Pathol [Internet]. 2019;13(4):618–23. Available from: http://dx.doi.org/10.1007/s12105-019-01021-5
13. Rooper LM, Jo VY, Antonescu CR, Nose V, Westra WH, Seethala RR, et al. Adamantinoma-like ewing sarcoma of the salivary glands: A newly recognized mimicker of basaloid salivary carcinomas. Am J Surg Pathol. 2019;43(2):187–94.
14. Umamahesweran S, Gochhait D, Jayachandran J, Govindarajan K, Siddaraju N, Srinivas BH. Cytomorphological features of adamantinoma-like Ewing's sarcoma in parotid masquerading as sialoblastoma in a paediatric patient. Cytopathology. 2020;31(3):228–31.
15. Fujii H, Honoki K, Enomoto Y, Kasai T, Kido A, Amano I, et al. Adamantinoma-like Ewing's sarcoma with EWS-FLI1 fusion gene: A case report. Virchows Arch. 2006;449(5):579–84.
16. Llombart-Bosch A, Machado I, Navarro S, Bertoni F, Bacchini P, Alberghini M, et al. Histological heterogeneity of Ewing's sarcoma/PNET: An immunohistochemical analysis of 415 genetically confirmed cases with clinical support. Virchows Arch. 2009;455(5):397–411.
17. Rooper LM, Bishop JA. Soft Tissue Special Issue: Adamantinoma-Like Ewing Sarcoma of the Head and Neck: A Practical Review of a Challenging Emerging Entity. Head Neck Pathol [Internet]. 2020;14(1):59–69. Available from: https://doi.org/10.1007/s12105-019-01098-y
18. Folpe AL, Goldblum JR, Rubin BP, Shehata BM, Liu W, Dei Tos AP, et al. Morphologic and immunophenotypic diversity in Ewing family tumors: a study of 66 genetically confirmed cases. Am J Surg Pathol [Internet]. 2005 Aug;29(8):1025–33. Available from: http://www.ncbi.nlm.nih.gov/pubmed/16006796
19. Weinreb I, Goldstein D, Perez-Ordoñez B. Primary extraskeletal ewing family tumor with complex epithelial differentiation: A unique case arising in the lateral neck presenting with horner syndrome. Am J Surg Pathol. 2008;32(11):1742–8.
20. Hafezi S, Seethala RR, Stelow EB, Mills SE, Leong IT, MacDuff E, et al. Ewing's Family of Tumors of the Sinonasal Tract and Maxillary Bone. Head Neck Pathol. 2011;5(1):8–16.
21. Kikuchi Y, Kishimoto T, Ota S, Kambe M, Yonemori Y, Chazono H, et al. Adamantinoma-like ewing family tumor of soft tissue associated with the vagus nerve: A case report and review of the literature. Am J Surg Pathol. 2013;37(5):772–9.

22. Bishop JA, Alaggio R, Zhang L, Seethala RR, Antonescu CR. Adamantinoma-like Ewing Family Tumors of the Head and Neck. Am J Surg Pathol [Internet]. 2015 Sep;39(9):1267–74. Available from: http://journals.lww.com/00000478-201509000-00013
23. Lezcano C, Clarke MR, Zhang L, Antonescu CR, Seethala RR. Adamantinoma-Like Ewing Sarcoma Mimicking Basal Cell Adenocarcinoma of the Parotid Gland: A Case Report and Review of the Literature. Head Neck Pathol [Internet]. 2015;9(2):280–5. Available from: http://dx.doi.org/10.1007/s12105-014-0558-0
24. Hameed M. Small Round Cell Tumors of Bone. Arch Pathol Lab Med. 2007;131(2):192–204.
25. Glasser DB, Lane JM, Huvos AG, Marcove RC, Rosen G. Survival, prognosis, and therapeutic response in osteogenic sarcoma. The memorial hospital experience. Cancer. 1992;69(3):698–708.
26. van der Woude HJ, Bloem JL, Taminiau AHM, Nooy MA, Hogendoorn PCW. Classification of histopathologic changes following chemotherapy in Ewing's sarcoma of bone. Skeletal Radiol. 1994;23(7):501–7.
27. García-Castellano JM, Atallah Yordi N, Reyes C, Healey JH. Histopathologic and radiologic assessment of chemotherapeutic response in Ewing's sarcoma: A review. Sarcoma. 2012;2012.
28. Min HS, Kang HG, Ro JY. Therapy Related Changes in Osteosarcoma and Ewing Sarcoma of Bone. Open Pathol J [Internet]. 2009 Sep 8;3(2):99–105. Available from: http://www.bentham-open.org/pages/content.php?TOPATJ/2009/00000003/00000002/99TOPATJ.SGM
29. Salet MCW, Vogels R, Brons P, Schreuder B, Flucke U. Maturation toward neuronal tissue in a Ewing sarcoma of bone after chemotherapy. Diagn Pathol [Internet]. 2016 Dec 9;11(1):74. Available from: http://diagnosticpathology.biomedcentral.com/articles/10.1186/s13000-016-0516-0
30. Ushigome S, Shimoda T, Nikaido T, Nakamori K, Miyazawa Y, Shishikura A, et al. Primitive neuroectodermal tumors of bone and soft tissue. With reference to histologic differentiation in primary or metastatic foci. Acta Pathol Jpn [Internet]. 1992 Jul;42(7):483–93. Available from: http://www.ncbi.nlm.nih.gov/pubmed/1414358
31. Knezevich SR, Hendson G, Mathers JA, Carpenter B, Lopez-Terrada D, Brown KL, et al. Absence of detectable EWS/FLI1 expression after therapy-induced neural differentiation in ewing sarcoma. Hum Pathol [Internet]. 1998 Mar;29(3):289–94. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0046817798900491
32. Smith LM, Adams RH, Brothman AR, Vanderhooft SL, Coffin CM. Peripheral primitive neuroectodermal tumor presenting with diffuse cutaneous involvement and 7;22 translocation. Med Pediatr Oncol [Internet]. 1998 Jun;30(6):357–63. Available from: http://www.ncbi.nlm.nih.gov/pubmed/9589085
33. Lowichik A, Zhou H, Pysher TJ, Smith L, Lemons R, Coffin CM. Therapy associated changes in childhood tumors. Vol. 7, Advances in anatomic pathology. 2000. p. 341–59.
34. Rajacic N, Ebrahim MK, Grgurinovic S, Starovic B. Foot reconstruction using vascularised fibula. Br J Plast Surg [Internet]. 1993;46(4):317–21. Available from: https://linkinghub.elsevier.com/retrieve/pii/000712269390011Y

35. Wang C-Y, Han P, Chai Y-M, Lu S-D, Zhong W-R. Pedicled fibular flap for reconstruction of composite defects in foot. Injury [Internet]. 2015 Feb;46(2):405–10. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0020138314005270
36. St. Hilaire H, Steele TN, Delatte S, Hebert CK, Canizares O. Metatarsal Reconstruction with a Fibular Osteocutaneous Flap. Plast Reconstr Surg Glob Open [Internet]. 2014 Nov;2(11):e258. Available from: http://journals.lww.com/01720096-201411000-00013
37. Peshin C, Das K, Ghaffar AA, Malik SH. Ewings Sarcoma of Fourth Metatarsal: A Rare Presentation. J Clin DIAGNOSTIC Res [Internet]. 2019; Available from: https://jcdr.net/article_fulltext.asp?issn=0973-709x&year=2019&volume=13&issue=1&page=RD06&issn=0973-709x&id=12468
38. Borthakur BB, Bannoth S, Boro S, Purkayastha J, Talukdar A, Kalita D. Vascularised Fibular Graft Reconstruction Following Resection of First Metatarsal Osteosarcoma: Case Report. Indian J Surg Oncol [Internet]. 2020 Apr 25; Available from: http://link.springer.com/10.1007/s13193-020-01060-3
39. Toriyama K, Kamei Y, Yagi S, Uchibori M, Nishida Y, Torii S. Reconstruction of the first and second metatarsals with free vascularised double-barrelled fibular graft after resection of a chondrosarcoma. J Plast Reconstr Aesthetic Surg [Internet]. 2009 Dec;62(12):e580–3. Available from: https://linkinghub.elsevier.com/retrieve/pii/S1748681508011431
40. Toma CD, Dominkus M, Pfeiffer M, Giovanoli P, Assadian O, Kotz R. Metatarsal reconstruction with use of free vascularized osteomyocutaneous fibular grafts following resection of malignant tumors of the midfoot: A series of six cases. J Bone Jt Surg - Ser A. 2007;

Figures

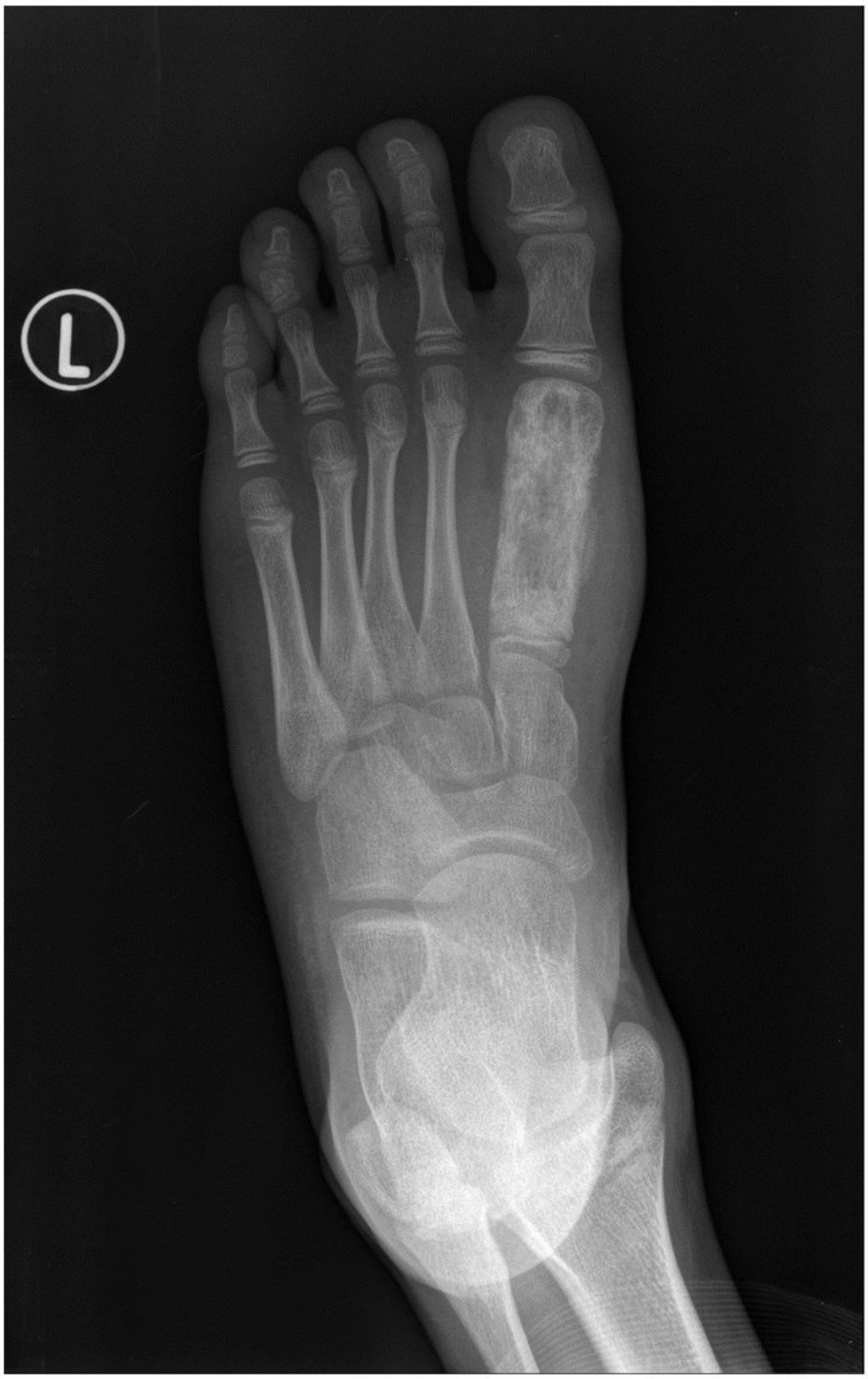

Figure 1

Antero-posterior radiograph showing a poorly defined mixed lytic and sclerotic lesion of the left first metatarsal.

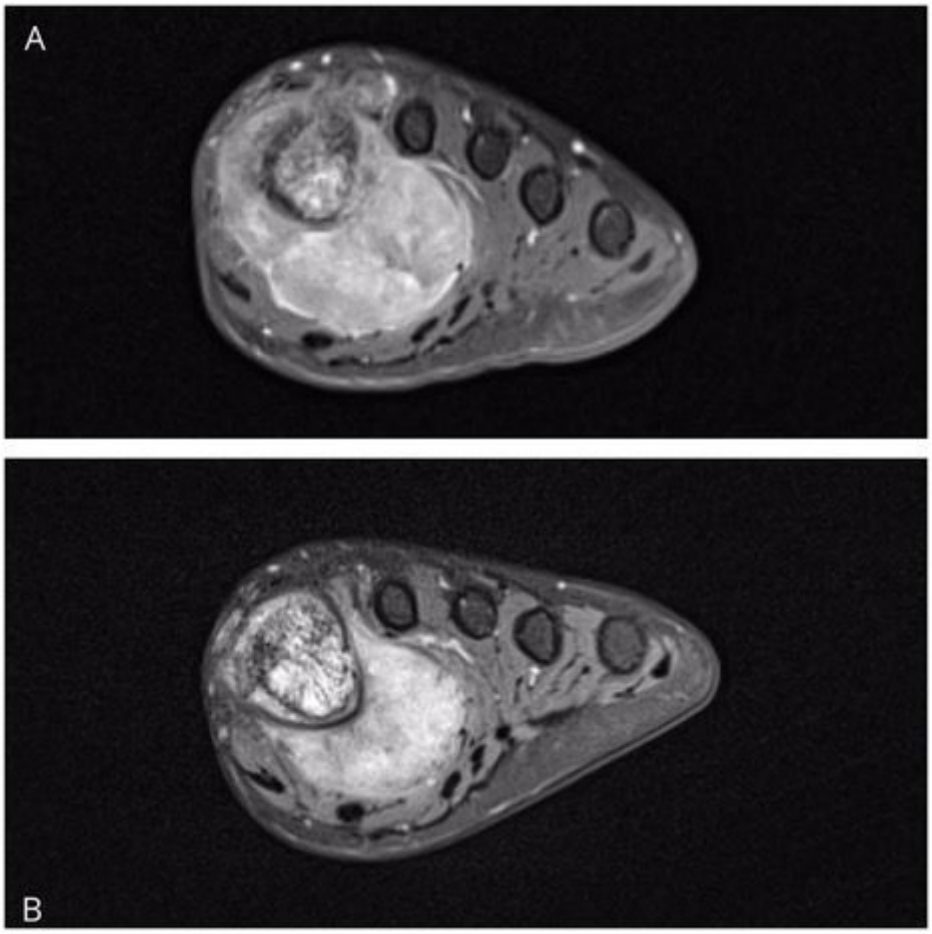

Figure 2

Magnetic resonance imaging scan showing a permeative destructive process involving the first metatarsal and large soft tissue component encasing the metatarsal (a) and subsequent interval decrease in size following neoadjuvant chemotherapy (b).

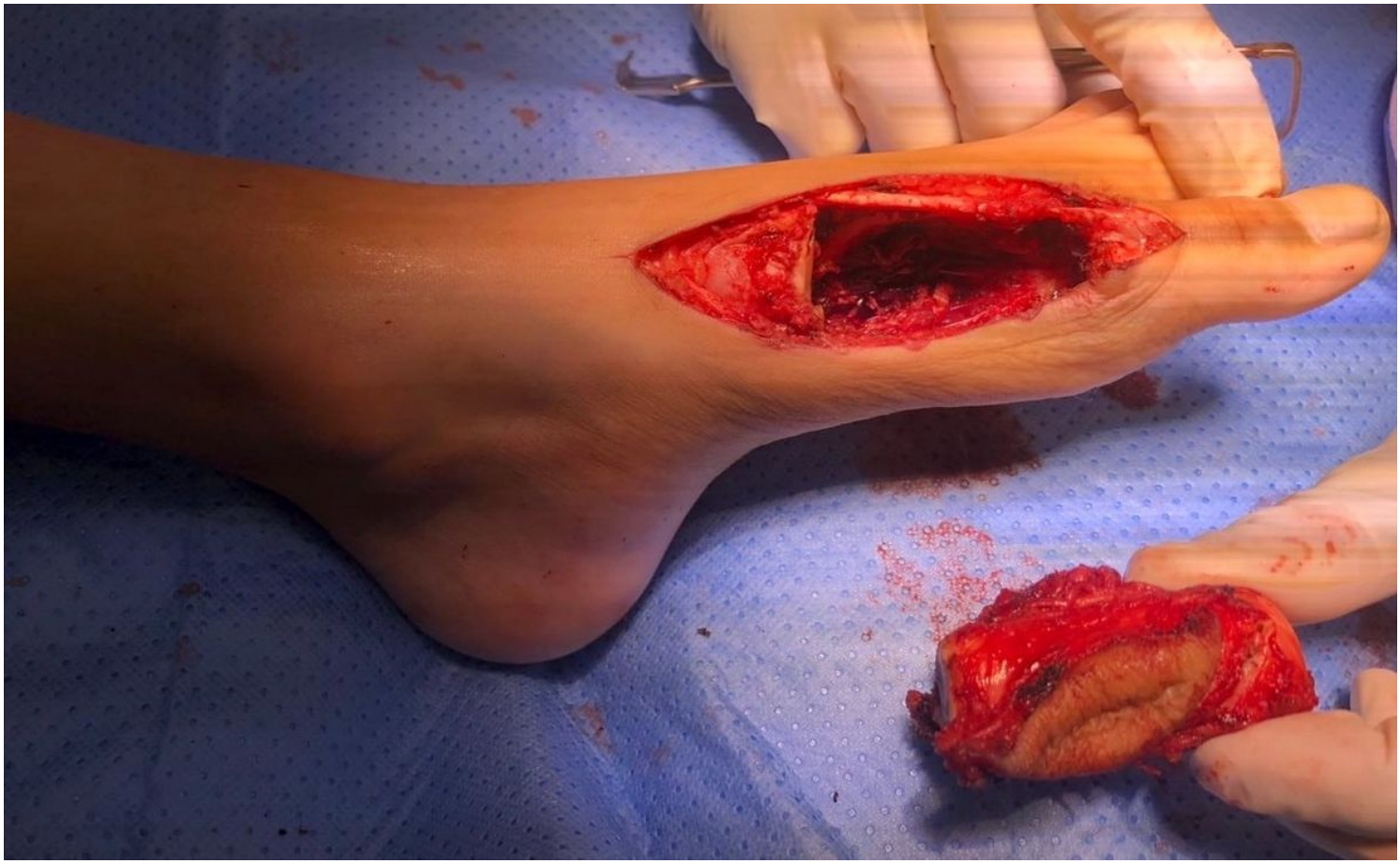

Figure 3

Wide resection of the first metatarsal through an antero-medial approach.

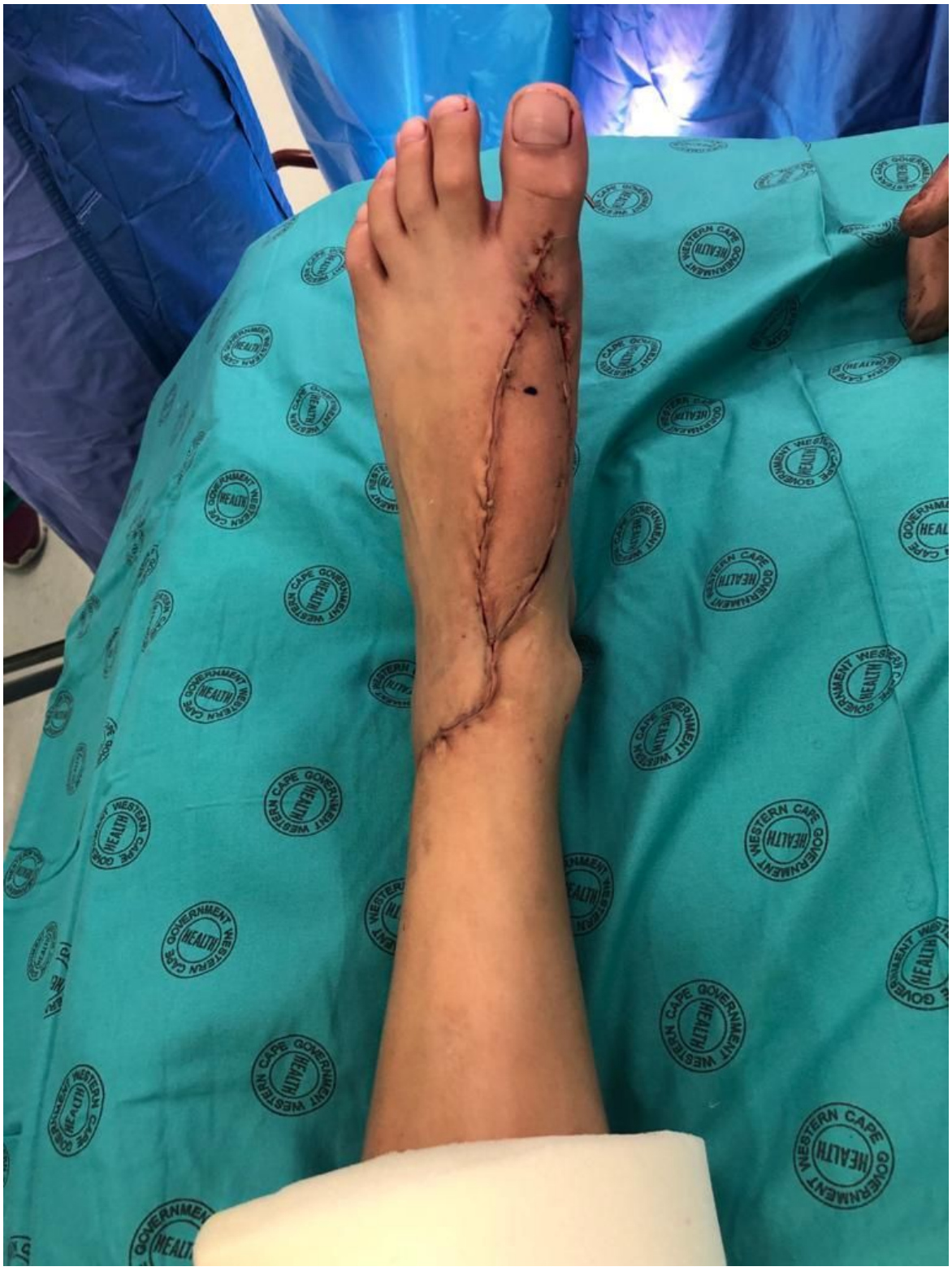

Figure 4

Soft tissue and bony defect reconstructed with an ipsilateral pedicled osteocutaneous fibula flap.

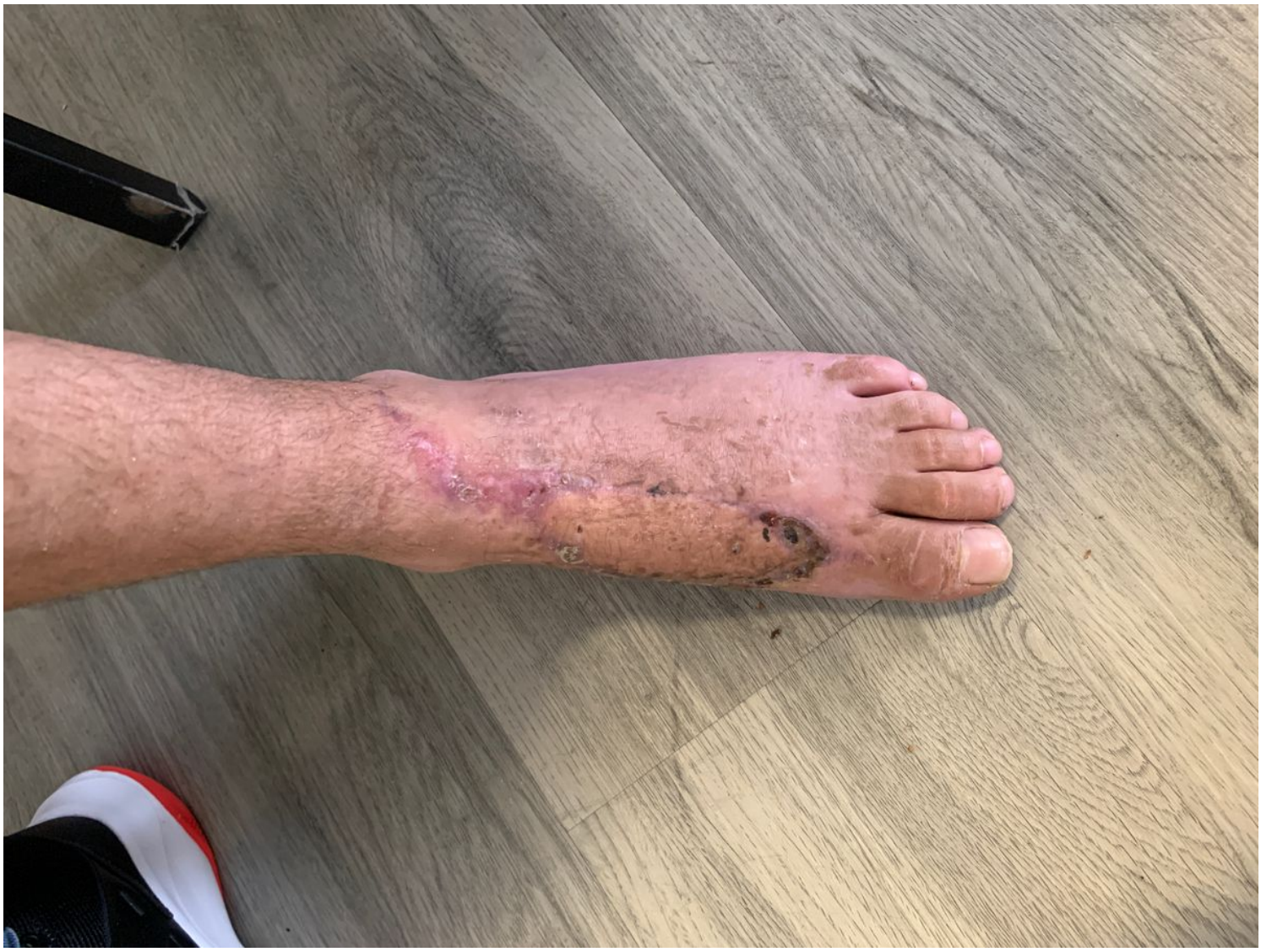

Figure 5

Plantigrade foot with healed cutaneous flap, three months after surgery.

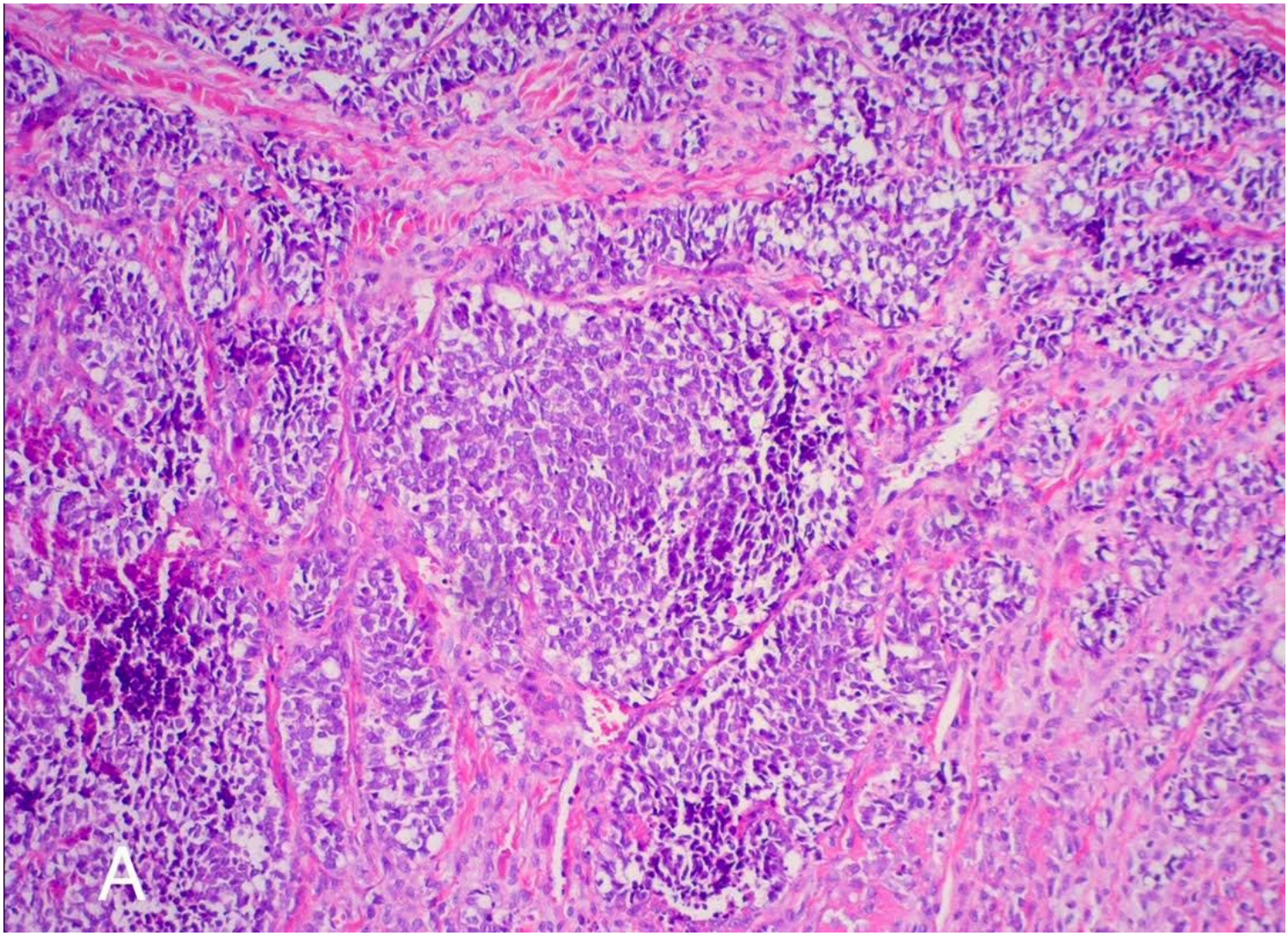

Figure 6

Microscopic image of the initial biopsy. Ewing's sarcoma showing a 'classic' growth pattern of nests of small round blue cells; H&E 100x.

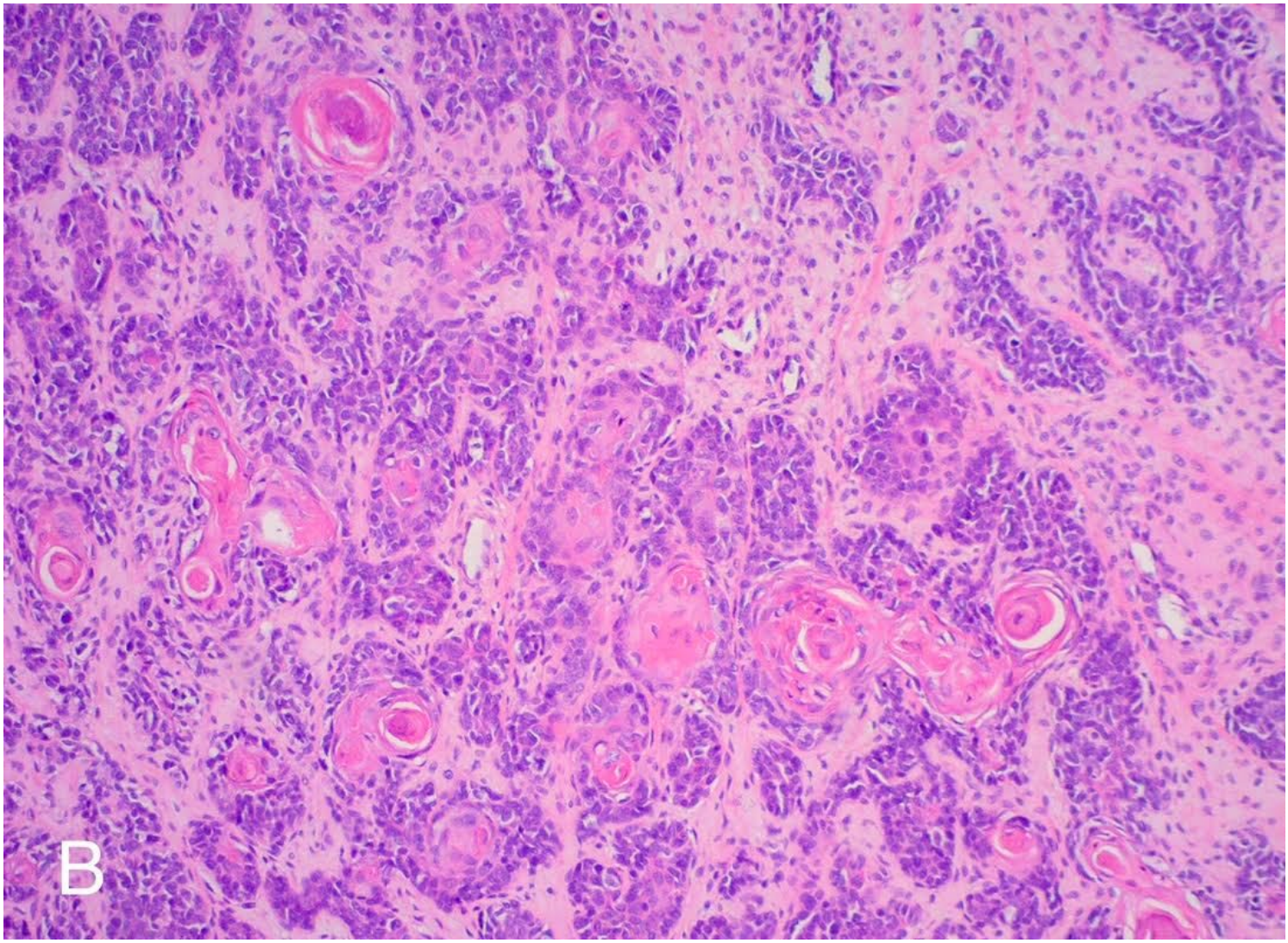

Figure 7

Microscopic image of the post neoadjuvant chemotherapy resection specimen. Adamantinoma-like Ewing's sarcoma with squamous differentiation and keratin pearl formation; H&E 100x.

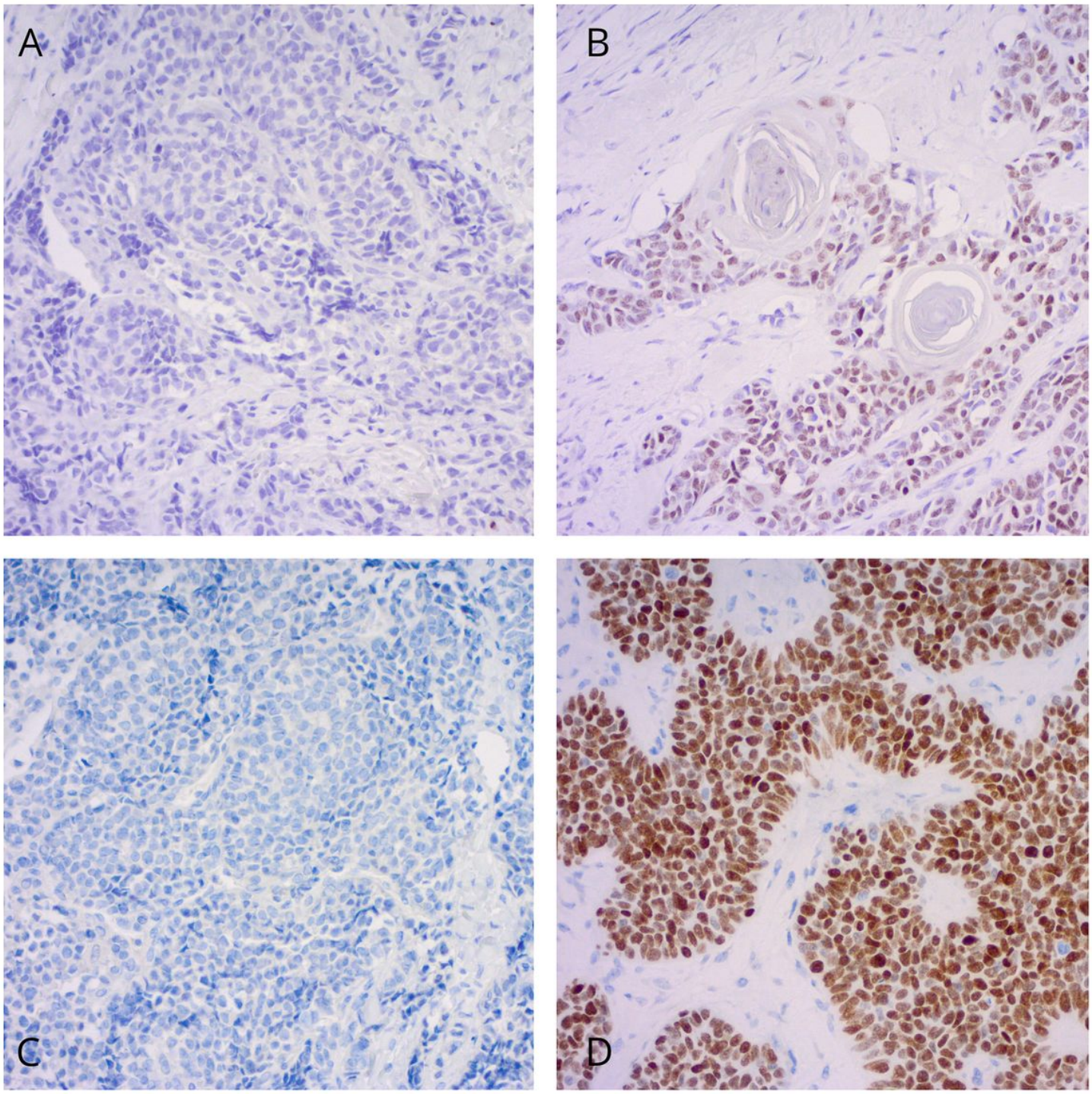

Figure 8

Immunohistochemical staining profile. a. Initial Ewing's sarcoma with negative P63 immunostain; 200x. b. Resection specimen Adamantinoma-like Ewing's sarcoma with positive P63 immunostian; 200x.c. Initial Ewing's sarcoma with negative P40 immunostain; 200x. d. Resection specimen Adamantinoma-like Ewing's sarcoma with positive P40 immunostain; 200x.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- CAREchecklist.pdf