



Case report

Pedicle screw system reconstruction in shoulder resection type IV-total scapulectomy: A case report and short term follow up

Yogi Prabowo, Riky Febriansyah Saleh *

Department of Orthopaedic and Traumatology, Faculty of Medicine, Universitas Indonesia, Dr. Cipto Mangunkusumo National Central General Hospital, Jakarta, Indonesia

ARTICLE INFO

Article history:

Received 22 February 2021

Received in revised form 20 April 2021

Accepted 22 April 2021

Available online 27 April 2021

Keywords:

Shoulder tumour

Scapulectomy

Pedicle screw

DASH score

ABSTRACT

Introduction: Shoulder resection remains a challenging procedure after scapulectomy for tumour resection. The results have various functional outcome, wound coverage, and cosmetic aspect. In this case report, we reported the outcome of pedicle screw application after scapulectomy procedure within 1 month follow up after surgical tumour excision.

Case presentation: A 74-year-old female presented with a painful lump on the left shoulder since nine months before admission. We performed physical examination, radiological evaluation using x-ray and MRI. We performed limb salvage surgery with shoulder girdle resection of tumour procedure using Malawer technique type IVB and applied pedicle and screw in proximal end clavicle and proximal end of humerus. We performed histopathological examination to ensure the tumour. We evaluated the patient one month after surgery using DASH score.

Discussion: MRI examination revealed that there was a solid mass with malignant characteristic destructing left scapular bone with the acromioclavicular and glenohumeral joint involvement. We used pedicle and screw to reconstruct the patient with efficient cost spending consideration. Clinical valuation showed there was no pain left and hand-free movement except the limitation of shoulder abduction. DASH score evaluation pre operative and post operative showed improvement from 70.8 to 45.0.

Conclusion: Limb salvage procedure using pedicle screw system may be one of treatment of choice for treating tumour of the shoulder affecting glenohumeral joint with excellent result of evaluation both clinical and functional outcome.

© 2021 Published by Elsevier Ltd on behalf of IJS Publishing Group Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

1. Introduction

The prevalence of shoulder tumour is approximately 15% of primary sarcomas. Shoulder is the third most common site, behind hip pelvis and the knee for the tumour growing. In the shoulder, lymphoma is slightly less common than Ewing sarcoma. Lymphoma includes many subtypes and, thus, has various in both clinical and radiographic presentations. Patients are typically older than 50 years and present with systemic signs such as fevers, chills, weight loss, and lymphadenopathy. Patients may present with bone pain that worsening with activity or because of pathological fracture, but rarely is shoulder pain the presenting symptom. Radiographic appearance can vary, but typically large, poorly marginated lytic lesions (with or without mixed sclerosis). It usually occurs in the diaphysis. In contrast to Ewing sarcoma, the periosteal bone formation is uncommon. Patients respond well to steroids and

chemotherapy and rarely require surgical intervention, even if the pathological fracture occurred [1].

Wide resection is the first-line treatment for sarcomas of the shoulder soft tissue. It resulted in large soft tissue defects. If treated inadequately, function of the shoulder and the overall upper extremity are impaired. Combined methods such as radiation therapy and systemic chemotherapy are used after wide tumour resection. A reliable and stable reconstruction procedure is a must to provide excellent active daily living outcome post-operative [2].

The latissimus dorsi flap is probably commonly used and reliable flap for reconstruction. Advantages include constant vascular anatomy, long and high-calibre vessels, high density of myocutaneous perforators to overlying skin, minimal morbidity at the donor site, and reduce of flap elevation. A pedicled latissimus dorsi flap can be used to repair the defect around the shoulder region. Wide resection is the only definitive surgical treatment for soft tissue sarcoma. Soft tissue reconstruction is necessary for extensive defects that occur after tumour resection. Highly mobile joints such as the shoulder should be covered by stable and durable soft tissue to avoid motion limitation [2]. Sarcoma extirpation of the shoulder and its girdle with an adequate margin often result in extensive defects of the overlying skin and functionally

* Corresponding author at: Department of Orthopaedic and Traumatology, Faculty of Medicine, Universitas Indonesia, Dr. Cipto Mangunkusumo National Central General Hospital, Jl. Pangeran Diponegoro No. 71, Senen, Central Jakarta, DKI Jakarta 10430, Indonesia.

E-mail address: riky.tujuh@gmail.com (R.F. Saleh).



Fig. 1. Anteroposterior and lateral examination revealed a bulging mass on the left shoulder area.

important muscles such as the deltoid and the trapezius. Disabilities of Arm, Shoulder, and Hand (DASH) score is the most favorable, reliable, and valid to evaluate the patient's upper extremity outcome [3–5]. However, reconstruction methods remain a challenge, and the functional outcome evaluation varies. Wound coverage, cosmetic, and active daily living problems must be solved to obtain satisfactory results of limb salvage in this region [6]. This report aim is to explain about functional outcome evaluation using the DASH score in the patient with pedicle screw application after scapulectomy procedure with 1 month follow up after surgical tumour excision.

2. Case illustration

A 74-year-old female presented with a painful lump on the left shoulder since nine months before admission. The lump was initially marble-sized and painless; however, it grew bigger by time and eventually became painful. Physical examination demonstrated solid mass and venectation on the posterolateral aspect of the shoulder. Mass measurement showed a diameter of 59 cm on the left shoulder with the limited motion (Fig. 1). Radiographic examination demonstrated partial destruction on the left scapula accompanied by left shoulder mass, suspected malignant, and osteopenia (Fig. 2). Magnetic Resonance Imaging (MRI) demonstrated solid mass with malignant characteristic. MRI examination revealed solid mass with malignant characteristic destructing left scapular bone and the acromioclavicular with glenohumeral joint involvement. The mass also infiltrated into left subscapular, supraspinatus, infraspinatus, deltoid and latissimus

muscles without major neurovascular infiltration. It was accompanied by axillar, infraclavicular, and hemithorax lymphadenopathy.

We performed shoulder girdle resection of tumour using Malawer technique type IVB or classic Tikhoff-Linberg resection. We used utilitarian shoulder girdle incision to excise the tumour. We performed proximal humerus osteotomy, lateral clavicle osteotomy, and later identified and preserved subclavian artery and vein and brachial plexus from the trunk, divisions, and cords. The tumour was exposed anteriorly. It grew and destroyed the whole left scapula. Tumour has infiltrated acromioclavicular and glenohumeral joints. It also infiltrated left subscapular, infraspinatus, supraspinatus, deltoid, and latissimus dorsi muscles. The size of the tumour was $13 \times 14 \times 17$ cm (Fig. 3). Resection of abductor muscles of shoulder girdle, and total scapula were performed. There was no involvement to the ribs, thoracic cage, and cervico-thoracic vertebrae. We applied pedicle screw and rod from Jantra® that connected proximal clavicle and proximal end of the humerus after osteotomy. We used pedicle screw number 5.5 with 35 mm length for clavicular bone and number 6.5 with 50 mm length for proximal end humeral bone (Fig. 4). We applied bone cement in the space between bone and pedicle. Final construction of the new shoulder was done. We performed Range of Motion (ROM) evaluation. The closure of the skin was performed using continuous sutured. We performed post-operative x-ray evaluation (Fig. 5).

Histopathological examination demonstrated malignant round cell tumour of the left shoulder. Laboratory examination demonstrated elevated aspartate aminotransferase of 46 U/L, elevated lactate dehydrogenase of 546 mg/L, and elevated alkaline phosphatase of 159 U/L. Preoperative

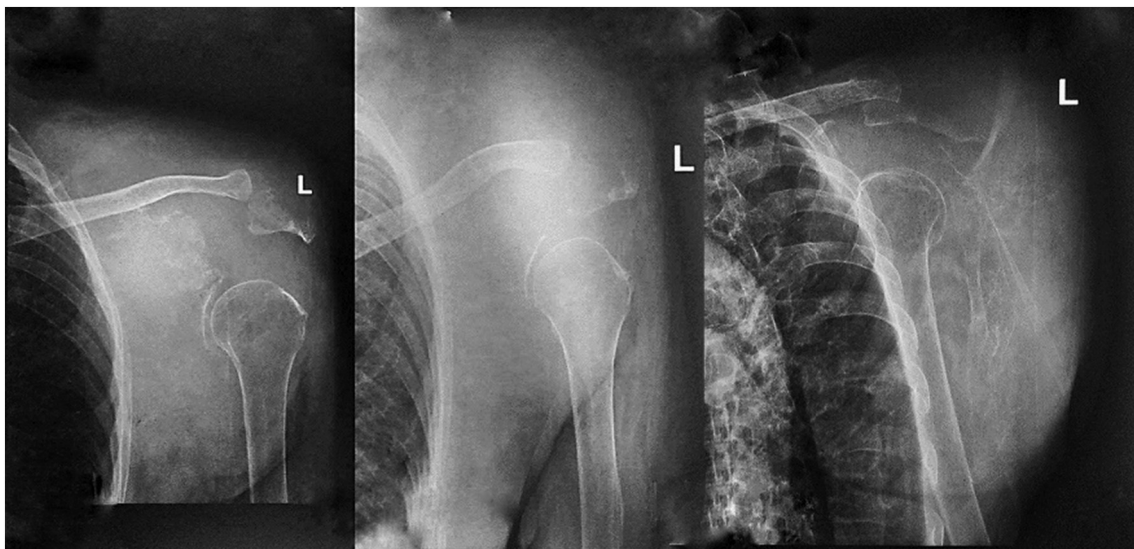


Fig. 2. Pre operative radiological examination showed primary tumour on one third distal of left clavicle bone.

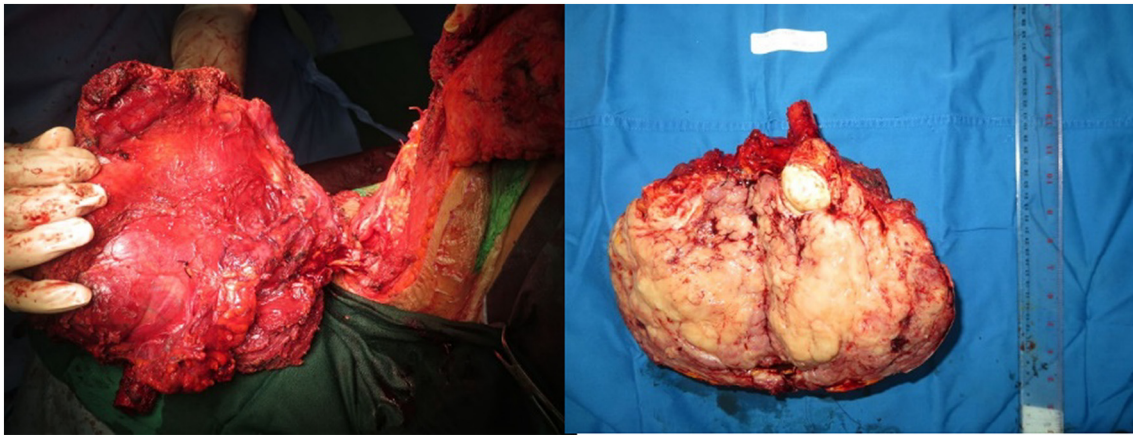


Fig. 3. Tumour removal and the size of the tumour.

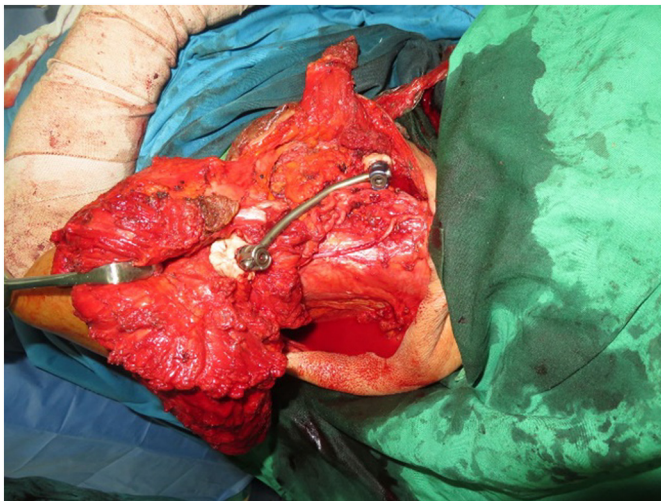


Fig. 4. Pedicle screw and rod application.

DASH score was 70.8. The patient underwent limb salvage surgery by wide excision and reconstruction using pedicle screw system. The patient achieved stable shoulder with preserved elbow and hand function (Figs. 6 and 7). DASH Score was 45.0 at 1-month follow-up. This study was carried out in compliance with the SCARE guidelines [7].

3. Discussion

The case we presented is a rare presentation of a primary soft tissue tumour of left shoulder region. Reconstruction of the shoulder after tumour resection is a challenge for orthopaedic surgeon. This is due to available reconstructive options may not adequately compensate for the functional deficits. Various reconstructive methods have been used, some of which were aimed on preserving shoulder mobility whereas others were aimed at shoulder arthrodesis [8]. In this case report, we performed limb salvage surgery by wide excision and reconstruction using pedicle screw system.

The shoulder girdle consists of the distal third of the clavicle, the scapula, and the proximal humerus and their surrounding envelope of muscles, nerves, and blood vessels. It is a common site of origin for

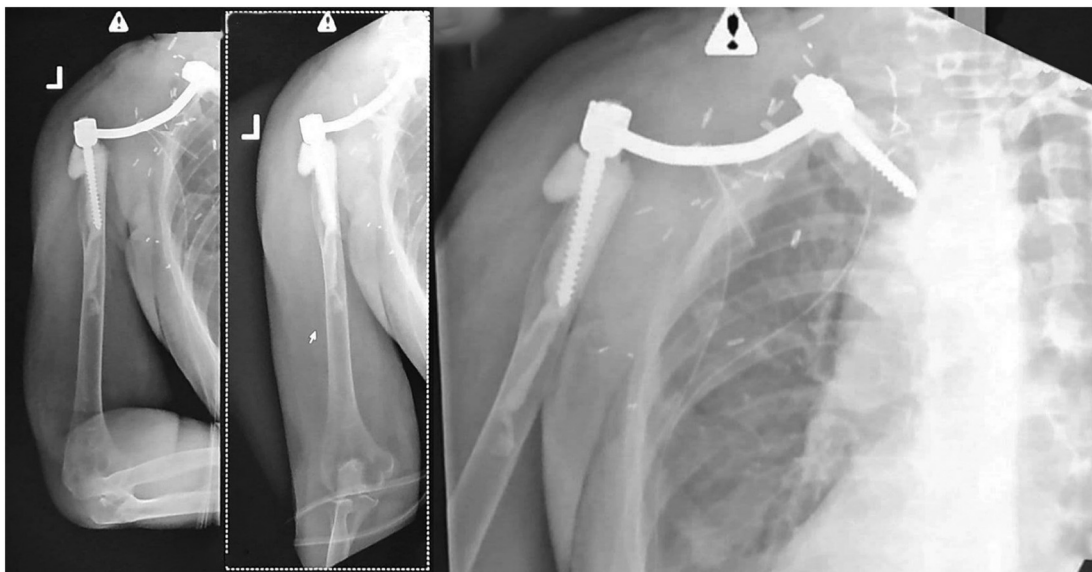


Fig. 5. Post operative radiological examination showed implant pedicle screw applied.



Fig. 6. Post-operation condition of the left shoulder.

high-grade primary bone sarcomas [9]. Limb-salvage resections of malignant tumours of the shoulder girdle has been considered high-risk procedures because of the proximity of these tumours to the neurovascular bundle, the extent of bone and soft tissue resection required, and the poor anticipated functional outcomes [10]. Moreover, the resection of the shoulder also carries the risk of damaging the adjacent muscle, deltoid muscle. The deltoid muscle is the primary generator for upper extremity movement and the most powerful muscle which plays role in elevation of the shoulder joint. Together with the rotator cuff muscles, it is also responsible for stabilization of the humeral head [11]. Retention of glenohumeral joint is very important for the function of forearm and hand [12]. Resections of large bone and soft tissue tumours were also thought to put the patient at risk of local recurrence. As a result, before the mid-1970s, shoulder disarticulation and forequarter amputation were the chosen treatment for patients with large tumours of the shoulder girdle. However, both procedures were associated with major functional disability and dismal cosmetic and psychologic outcomes [13]. In this case, our limb salvage surgery resulted in preserved hand and elbow function and also result in a stable shoulder. The patient also had satisfactory overall function and was pain-free. The following indications for scapulectomy are sarcoma or skin carcinoma involving scapula or scapular muscle, chronic osteomyelitis of the scapula, severe trauma, primary malignant musculoskeletal tumour both in scapula and its surrounding, and solitary metastatic tumour to the scapula [14]. This procedure preserves effective function in the arm and hand, and also the glenohumeral joint. Although, it gives limitation in shoulder abduction [14]. Soft tissue procedure

is very important to provide glenohumeral stability and sufficient soft tissue coverage [4,14,15].

Each reconstructive method has its particular advantages and disadvantages. The choice of reconstructive technique should be patient-tailored. In addition to the extent of bone and soft tissue loss, the age and functional demands of the patient are important considerations [16]. In our case, the patient felt satisfied to be pain-free with good movement function of the arm and hand. There are several postoperative complications that might occur in the patient with this procedure, such as wound infection and dislocation in prosthetic usage [17]. Functional outcome may vary based on the severity of grading of tumour, any local recurrence, and any metastasis. Poorer outcome usually occurs in high-grade tumour, local occurrence, and (pulmonary) metastasis [4]. DASH score is the most recommended parameter to evaluate functional outcome postsurgical tumour resection [3]. DASH score is usually used because it can refer to patient daily activities with their upper extremity [18].

Various reconstructive methods may be used in such cases. The rationale between which procedure to use in treating scapular tumour depends on anatomical involvement of the tumour. In tumour affecting scapular region without adjacent shoulder girdle, partial scapulectomy without reconstruction may be performed. However, in our patient, the mass also infiltrated acromioclavicular and glenohumeral joint. Resection in such region is challenging, in which surgeons should attempt to preserve neurovascular, rotator cuff, and muscles in the shoulder girdle for functional outcome. After resection, current options of reconstruction include humeral suspension (flail shoulder), use of endoprosthesis (constrained or non-constrained), and bone allograft [17].



Fig. 7. Post-operation hand movement evaluation.

Humeral suspension may be an option in limb-salvage technique when no further reconstructive approach is possible. Mayil Vahanan et al. [12] reported that scapulectomy without reconstruction in shoulder girdle showed excellent/good results in 13 patients and fair/poor results in the remaining 10 patients. Disadvantage in humeral suspension is the restriction in shoulder abduction as its major functional limitation [12,17].

Prostheses, allograft, or allograft-prosthesis composites are the common reconstructive procedure in postresection patients of scapular tumour affecting glenohumeral joint. The aim of prostheses reconstruction in scapula is to form connection between chest wall and arm to preserve function by prevent traction on brachial plexus and fill the defects after tumour resection [17,19]. Yang et al. [20] showed that prosthetic implantation resulted in satisfactory functional recovery. Functional outcome was higher than patients treated with humeral suspension, in which there was compromised function and bad cosmetic results due to asymmetrical form, neckline contour, also residual deformity.

Teunis et al. [19] compared the use of prostheses, allograft, and allograft-prosthesis composites in reconstructive surgery after resection in shoulder tumours involving proximal humerus. Implant survival and functional score using MSTS score was similar in all groups, with the score ranging from 60% to 79%. However, allograft groups showed higher rate of fractures as complication. The study showed no difference in overall outcomes between reconstruction using prosthesis and allograft-prosthesis composites.

Another study performed resection of musculoskeletal tumour in scapula with limb salvage surgery (scapulectomy) and followed by total arthroplasty using constrained mega prosthesis [21]. The patient was given neoadjuvant chemotherapy before surgery. Evaluation of this procedure using DASH score was improved from 62.6 to 42.6 within 3-week follow up.

However, prosthesis and allograft-prosthetic composites were associated with nondurability particularly in young patients. Also, there may be the risk of prosthetic implant and revision arthroplasty failure. In such condition, another reconstruction surgery such as arthrodesis may be used. Indication of arthrodesis includes insufficiency of rotator cuff and deltoid muscles, posttraumatic brachial plexus injury, failed revision arthroplasty, paralytic disorders, and patients with severe refractory instability. Surgeons may also perform arthrodesis in patients with bone deficient after tumour resection. Arthrodesis may provide favorable outcome particularly in young patients that require full mobilization. Fuchs et al. reported that mean MSTS score in primary arthrodesis was 24 points (range, 18–27 points). However, the complication rate is relatively high, ranging from postoperative pain to nonunion. 43% patients underwent arthrodesis in the study required major surgical intervention due to complications [16].

In our study, we performed limb salvage surgery by wide excision and reconstruction using pedicle screw system. Use of pedicle screw system in our patient showed satisfactory result, with an improvement in DASH score from 70.8 to 45.0 in 1-month follow-up. Although prosthetic implantation is a common reconstructive procedure after tumour resection in scapula affecting glenohumeral joint, the expense is relatively high and may not be applicable in use particularly in developing countries, such as Indonesia. We then provide another alternative reconstructive procedure especially in patients with economic burden. In our patient, pedicle screw system that were originally used in spine showed good functional outcome in postresection procedure in scapular tumour affecting glenohumeral joint.

4. Conclusion

Limb salvage procedure using pedicle screw system has shown successful for treating tumours of the shoulder affecting glenohumeral joint. Reconstruction using pedicle screw system showed improvement in DASH score after 1-month follow up. Moreover, it is cost-effective

and could be performed in hospitals with limited facilities. Therefore, we recommend the use of pedicle screw system as an alternative reconstructive procedure. Further studies are required to investigate the safety and efficacy of this procedure.

Disclaimer

No patient or author details are included in the figures.

Funding

The authors report no external source of funding during the writing of this article.

Ethical approval

Ethical approval was not required in the treatment of the patient in this report.

Research registration number

Does not need any registration.

Guarantor

Yogi Prabowo, MD.

CRediT authorship contribution statement

Yogi Prabowo contributes in the study concept or design, data collection, analysis and interpretation, oversight and leadership responsibility for the research activity planning and execution, including mentorship external to the core team.

Riky Febriaansyah Saleh contributes to the study concept or design, data collection and writing the paper.

Declaration of competing interest

The authors declare no conflicts of interest.

References

- [1] D.H. Lee, J.M. Hills, M.I. Jordanov, K.A. Jaffe, Common tumours and tumour-like lesions of the shoulders, *J. Am. Acad. Orthop. Surg.* 27 (7) (2018) 236–245, <https://doi.org/10.5435/JAAOS-D-17-00449>.
- [2] J.S. Kim, J.S. Lee, J.O. Yoon, J.B. Park, Reconstruction of the shoulder region using a pedicled latissimus dorsi flap after resection of soft tissue due to sarcoma, *Br. J. Plast. Surg.* 62 (9) (2009) 1215–1218.
- [3] S. Harrington, L.A. Michener, T. Kendig, S. Miale, S.Z. George, Patient-reported upper extremity outcome measures used in breast cancer survivors: a systematic review, *Arch. Phys. Med. Rehabil.* 95 (1) (2014) 153–162.
- [4] S.P.F.T. Nota, M.J.A.M. Russchen, K.A. Raskin, H.J. Mankin, F.J. Hornicek, J.H. Schwab, Functional and oncological outcome after surgical resection of the scapula and clavicle for primary chondrosarcoma, *Musculoskelet. Surg.* 101 (1) (2017) 67–73.
- [5] D.R. Leblanc, M. Schneider, P. Angele, G. Vollmer, D. Docheva, The effect of estrogen on tendon and ligament metabolism and function, *J. Steroid Biochem. Mol. Biol.* 172 (2017) 106–116.
- [6] K. Ihara, M. Shigetomi, K. Muramatsu, et al., Pedicle or free musculocutaneous flaps for shoulder defects after oncological resection, *Ann. Plast. Surg.* 50 (4) (2003) 361–366.
- [7] R.A. Agha, T. Franchi, C. Sohrabi, et al., The SCARE 2020 guideline: updating Consensus Surgical CAse REport (SCARE) guidelines, *Int. J. Surg.* 84 (2020) 226–230, <https://doi.org/10.1016/j.ijsu.2020.10.034>.
- [8] S.N. Amin, W.A. Ebeid, Tumour resection by pedicled scapular crest graft, 397 (2002) 133–142.
- [9] A. Shehadeh, A.F. Ja'far, U. Isleem, A. Hamad, A. Salem, Shoulder girdle resection: surgical technique modification and introduction of a new classification system, *World J. Surg. Oncol.* 17 (107) (2019) 1–11.
- [10] N.M. Stevens, H.M. Kim, A.D. Armstrong, Functional outcomes after shoulder resection: the patient's perspective, *J. Shoulder Elb. Surg.* 24 (9) (2015) e247–e254.
- [11] K. Muramatsu, K. Ihara, Y. Tominaga, T. Hashimoto, T. Taguchi, Functional reconstruction of the deltoid muscle following complete resection of musculoskeletal sarcoma, *J. Plast. Reconstr. Aesthet. Surg.* 67 (7) (2014) 916–920.

- [12] N. Mayil Vahanan, P. Mohanlal, J.C. Bose, R. Gangadharan, V. Karthisundar, The functional and oncological results after scapulectomy for scapular tumours: 2–16-year results, *Int. Orthop.* 31 (6) (2007) 831–836.
- [13] J. Bickels, J.C. Wittig, Y. Kollender, K. Kellar-graney, I. Meller, M.M. Malawer, Limb-sparing resections of the shoulder girdle, 7515 (02) (2002) 422–435.
- [14] S.F. Xu, X.C. Yu, M. Xu, Y.C. Hu, X.P. Liu, Functional results and emotional acceptance after scapulectomy for malignant shoulder tumours, *Orthop. Surg.* 8 (2) (2016) 186–195.
- [15] Y. Kitagawa, D.M. Thai, P.F. Choong, Reconstructions of the shoulder following tumour resection, *J. Orthop. Surg.* 15 (2) (2007) 201–206.
- [16] B. Fuchs, M.I.O. Connor, D.J. Padgett, K.R. Kaufman, F.H. Sim, Arthrodesis of the shoulder after tumour resection, *Clin. Orthop. Relat. Res.* 436 (2005) 202–207.
- [17] A. Biazzo, M. De Paolis, D.M. Donati, Scapular reconstructions after resection for bone tumours: a single-institution experience and review of the literature, *Acta Biomed* 89 (3) (2018) 415–422.
- [18] A. Leithner, M. Glehr, S. Scheipl, R. Windhager, Evaluation of macroamputations of the upper extremity in the management of primary malignant bone and soft-tissue tumours using the DASH score, *Handchir. Mikrochir. Plast. Chir.* 40 (1) (2008) 19–22.
- [19] T. Teunis, S.P.F.T. Nota, F.J. Hornicek, J.H. Schwab, S.A. Lozano-Calderón, Outcome after reconstruction of the proximal humerus for tumour resection: a systematic review, *Clin. Orthop. Relat. Res.* 472 (7) (2014) 2245–2253.
- [20] Q. Yang, J. Li, Z. Yang, X. Li, Z. Li, Limb sparing surgery for bone tumours of the shoulder girdle: the oncological and functional results, *Int. Orthop.* 34 (6) (2010) 869–875.
- [21] M.D. K., B. Vijayan, A rare case of osteosarcoma scapula treated with custom made shoulder prosthesis, *J. Evid. Based Med. Healthc.* 2 (47) (2015) 8361–8363.