An alternative treatment option to microsurgery for tissue defects of the anterior side of the tibia: Bipediculated flap

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ABSTRACT

In addition to soft tissue and bone tissue injuries as a result of high-energy trauma against the lower extremities, serious tissue losses may occur following tumor surgeries. For the reconstruction of this region, there are various options. The preferred methods of reconstruction vary with respect to the experience and knowledge of the surgeon. In this case, the mega prosthesis used following a tibia tumor resection by virtue of local flaps is discussed.

Key words: Bipediculated flap, lower extremity, reconstruction

Introduction

Following that distal to the femur, the second most common localization of primary bone tumors is proximal to the tibia [1]. While in the past, primary treatment of bone tumors was through amputation, extremity-protecting surgeries have replaced surgical amputation as the mean expected lifetime has increased by virtue of neoadjuvant chemotherapy and radiotherapy [2,3]. In extremity-protecting surgeries, the frequency of mega prosthesis usage has been gradually rising for the purpose of bone reconstruction [4]. Especially in small children, while the length of the extremity elongates, growth ceases in surgical treatments including epiphyses on the affected side and inequality in height development [5]. In order to prevent height inequality, a prolonging prosthesis prepared specifically for the patient is preferred [6,7]. With this, in the latter period of life, it is possible to equalize height through external electromagnetic impulse [7].

In bone tumor surgeries, soft tissue excisions may also be required [8]. As soft tissue defects are formed, particularly in cases in which a mega prosthesis used to grow, reconstruction becomes more difficult and free tissue transplantations are increasing [9].

Free tissue transplantation in children may create uncertainty, especially with surgeons who new to microsurgery [10]. Moreover, one of the anterior and posterior arteries may be sacrificed during excision in bone surgeries of the leg and in that case, the extremity becomes fed by a single vessel. Thus, particularly in late reconstruction, receiving vessel options are limited and surgeons need long pediculated flaps with end-to-side anastomoses.
Moreover, in each free flap, a second morbidity is present in the donor field and this situation may be very frustrating for surgeons in the likelihood there are flap losses. Therefore, reconstructions made with local tissues are those which will be most easily tolerated by the patient.

In this study, reconstruction of the exposed mega prosthesis following the osteosarcoma excision at the proximal end by using local tissues is described and the advantages and disadvantages of the current treatment with other probable treatment options are discussed.

Case Report

In a twelve-year-old female child, reconstruction was carried out with a tibia proximal resection from the osteosarcoma of the proximal region of the right tibia and an exclusively prepared extensible tumor prosthesis was achieved (Figure 1). As prosthesis was totally exposed at the post-operative twelfth day, the patient was consulted by the plastic surgery team. In the physical examination, a soft tissue defect of 25x10 centimeters in diameter in total beginning from the top of patella and ending beyond seven (7) centimeters past the ankle and an exposed mega prosthesis with this defect were seen (Figure 2). First, a free latissimus dorsi muscle skin flap was planned in the patient, however because the dimension of the defect was large and the posterior tibial artery of the patient was ligated with the oncologic surgery, as well as because the likely flap loss would result in extremity loss, whether there was a local option or not was investigated. In the physical examination, it was seen that the flaps at the medial and the lateral borders of the wound could be approached at the midline, but a little gap was seen between them. So, two flaps were designed with 9x22 centimeter dimensions...
in medial and lateral soft tissues in the patient. Flaps were dissected by cutting flaps at the posterior and at the midline in the calf and by including fascia in a bipediculated fashion and these were sutured bilaterally (Figure 3a-b). The defect appeared on the gastrocnemius muscle at the posterior and was repaired with a graft in partial thickness. At the post-operative eighteenth month, it was observed that the wound covering the patient was complete without any signs of extrusion and infection. Also, the extremity extending procedures were continuing unintentionally (Figure 4 a-b).

Discussion

Mega prosthesis’ are being used with increasing frequency in protective surgeries [8]. In cases where a large prosthesis is used and soft tissue excisions are also made, wound opening sites are the most commonly seen complications. In tissue losses in the lower extremities, vacuum-assisted covering methods and free flaps are more preferable [11,12]. Additionally, in the presence of an exposed prosthesis, extremity vacuum-assisted covering methods have no indication. In cases where large vessels are not included in the specimen, free tissue transplantation is an important tool [10]. Among free flap options, latissimus dorsi muscle-skin flap or rectus abdominis muscle flap can be utilized in cases where muscle coverage is desired [12]. Prosthesis coverage with reconstruction with Anterolateral Tie (ALT) flap can be ensured when either muscle is intended to be used by including vastus lateralis for a muscle-skin flap or with skin flap without muscle [9]. On the other hand, free flaps may possess difficulties either for the patient or for the surgeon. If there is a local coverage option, this may be preferred based on the morbidity that occurs in a different region, prolonged surgery time, receiving vessel restrictions in oncologic cases and from the fact that there are more technical difficulties in free tissue transplantations in children [10].

In the case presented here, because the posterior tibial artery was included in the tumor specimen, end-to-side anastomosis might have been planned for the anterior tibial artery. However, in order to avoid risk when receiving an artery and so as to not cause additional morbidity to the patient in the flap donor field, it was decided to create a local flap option.

Bipedicled local flaps were previously used for the reconstruction of the anterior tibial defects in two previous studies by Darwish [13] and Ver Halen [14]. Darwish used bipedicled flaps for the exposed tibia but the defect sizes were much smaller than the ones presented [13]. Van Halen also presented a case series of anterior tibial defects with bipedicled flaps combining soleus and gastrocnemius muscle flaps. Although successful results were presented, there were also some wound complications, and adding muscle flaps to bipedicled fasciocutaneous flaps did not prevent these wound problems. As muscle flaps also lead to significant morbidity, it is believed that saving the muscles and using them when bipedicale flaps fail for the cover would be more logical [14].

When other local flap options were considered, one can also determine the sural flap for the reconstruction of anterior tibial defects, especially at the level of ankle [15]. Yet, when there are huge defects, as has been mentioned, the sural flap is not an option. When Taylor concepts or other angiosome concepts are studied, it is seen that there are more than 40 perforators in the leg [16]. The random flap width/height ratios suggested in the lower extremities are one-to-one [17]. The width ratios of the prepared flaps in the patient presented in this study were 1:2. On the other hand, as a consequence of either the patient being a child or because of the delay effect related with the feeding of the flaps from the medial boundaries, no circulation impairment was seen in the flaps. Nonetheless, had the patient been an adult and if the reconstruction was planned before the delay effect began just after the acute injury, the preservation of width/height ratio of the flap, specifically a one-to-one ratio, would reduce the circulation defects of the flap.

Overall, bipediculated local flaps should be kept in mind in cases where secure width-height ratios are ensured and there is a soft tissue defect on the tibia in the lower extremity. On the other hand, we suggest that direct free tissue transplantations will minimize the likely wound complications in situations that exhibit great soft tissue loss and secure width-height ratios cannot be achieved.

Conflict of interest statement

The authors have no conflicts of interest to declare.
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