Functional Results of Rotationplasty
Analysis and Commentary of the Enneking Evaluation System

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Summary. Rotationplasty is a standard method of surgery for treatment of malignant bone tumors of the distal part of the femur. Compared with the hitherto accepted methods of limb salvage—endoprosthesis, allograft, and resection arthrodesis—rotationplasty seems to give better oncological and functional results. Thus far, at the Orthopedic Hospital Vienna, we have had experience of 49 cases of rotationplasty with a follow-up of 3–10 years. With respect to the emotional acceptance of this method, the results of this study were particularly revealing.

The functional results according to the evaluation schema of Enneking show in most cases good and excellent results. More than 80% of the patients actively and regularly engage in sporting activities. From these results, it is no longer justifiable to reject rotationplasty in principle as a therapeutic alternative in treating malignant bone tumors of the distal part of the femur.

Key words: Bone tumor—Rotationplasty—Functional evaluation system

It is a well-known fact that the knee joint is the main location of primary malignant bone tumors. For this reason, the local treatment of tumors of this region occupies a central position in therapeutic considerations.

The objectives of surgical treatment are as follows: (a) Improvement of survival, i.e., oncologically sufficient elimination of the primary tumor; (b) optimal functional rehabilitation.

There are four possibilities in the surgical treatment of tumors around the knee joint: above-knee amputation, rotationplasty, endoprosthesis, and resection arthrodesis. Which of these measures should be given preference in an individual case is largely dependent on the primary objective—the survival of the patient. In principle, the method of operation selected should be the one which gives the patient the greatest chance of survival. The question of functional rehabilitation arises when equal or similar chances of survival are offered by several methods.

The choice of the method of operation depends to some extent on the patient, but mainly it depends on the attitude of the treatment center in each case. As a result of their own experience, physicians generally prefer one or other of the
four possible methods of operation. For this reason, it is very difficult to compare the results, as no one center has equal experience of all four methods of operation.

In 1983, Enneking in Vienna presented a system of classification that was designed to facilitate comparison of the functional results of different surgical approaches [1]. This system represented a first step toward the uniform evaluation of different methods, but it still requires modification.

As mentioned above, four very different methods of operation must be compared for the anatomical region of the knee joint. In view of the fact that our own department has many years of experience with rotationplasty [3–5] (the first operation of this kind we did took place as long ago as 1974), the present paper sets out to analyze the extent to which the system of classification recommended by Enneking can be applied to this method of operation.

**Knee Evaluation System (Enneking)**

It is virtually impossible to compare the four methods with regard to evaluation of the first criterion, the mobility of the knee joint, as the situation is different in each case. In the case of arthrodesis, there is a complete absence of mobility of the knee joint, and in the case of amputation this mobility depends on the design of the prosthesis. Only rotationplasty and the endoprosthesis are comparable, as both methods offer both passive and active mobility.

The subjective perception of pain is a parameter that can be applied to all four methods.

The evaluation of varus/valgus instability or giving way specified under stability cannot meaningfully be applied to either rotationplasty or above-knee amputation, as these problems are not encountered if a suitable prosthesis is fitted. Evaluation should be confined to the loadability of the extremity. A clearly defined criterion would be the necessity of using supports.

The three criteria listed under deformity—varus/valgus position, flexion contraction, and shortening of the leg—are also not applicable to rotationplasty or amputation. The only sensible common criterion here is the evaluation of gait—based on the degree, constancy, and severity of the limp.

Strength, measured in terms of the ability to overcome gravity in an extended position, is hardly applicable as a common criterion for evaluation either, as only rotationplasty and the endoprosthesis offer an active possibility of extending the lower leg. Such active extension is not possible with arthrodesis or above-knee amputation.

The criteria of functional activity and emotional acceptance are suitable for the evaluation of all four methods of operation and thus represent suitable evaluative parameters.

In view of these circumstances, there is no overall rating incorporating all seven evaluative criteria specified by Enneking that would be suitable for an objective comparison of the results of rotationplasty with the alternatives of amputation, endoprosthesis, and resection arthrodesis. In any evaluation of results, it is, therefore, necessary to apply only criteria that are equally applicable to all four methods.