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Case Report

Reconstruction of condyles by transport distraction osteogenesis: 3 case report with complication management

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ABSTRACT

Objective: The aim of this case report is to evaluate the clinical outcomes that including minor postoperative complications of the transport distraction osteogenesis (TDO) for reconstruction of the ramus-condyle unit.
Study design: We present 3 cases of the ramus-condyle unit reconstruction after the resection of bone tumors. All three bone tumors were excised intraoperatively and the histologic assessment confirmed the clinical diagnosis of osteochondroma, condylar hyperplasia, and osteoma.
Results: Although postoperative minor complications were noted; all patients had satisfactory lateral and protrusive jaw movements, and also adequate mouth openings.
Conclusion: TDO for reconstruction of the ramus-condyle unit is an effective treatment modality for TMJ reconstruction. However, after condylectomy with resection of the condylar neck, it seems to be a reliable approach to adjust the distraction vector slightly posterior to maintain the transport segment in glenoid fossa to prevent the premature contact of bony segments, especially for individuals who have shorter anteroposterior ramus length in the axial plane.

1. Introduction

Benign and malign bone tumors that originate from mandibular the condylar region are rarely encountered [1–3]. Osteochondroma is defined as a benign bone tumor that commonly occurs in the cortex of long bones such as the tibia and femur. Although osteochondromas are rarely located in the oral and maxillofacial region, the coronoid process and condylar regions of jaws are the most frequently affected orofacial sites [4]. Also, condylar hyperplasia is a rare pathologic malformation that causes facial asymmetry and occlusal discrepancy via progressive overgrowth of the condylar process, and an appropriate treatment approach is mandibular condylectomy [5].

Osteoma is a benign fibro-osseous tumor that develops from craniofacial bones. Three distinct types of osteoma are classified according to their histological origin in the literature. Central osteoma arises from endosteum, and the peripheral type of osteoma arises from periosteum of affected bones. Also, extraskeletal soft tissue osteoma arises from muscles [6].

Several surgical techniques have been proposed for the treatment of these kinds of benign bone tumors and TMJ ankylosis. For this purpose, costochondral [7] and iliac crest [8] grafts are used for the reconstruction of TMJ. However, these techniques increase the time of operation and may be associated with donor site morbidity as a common complication [9].

Distraction osteogenesis is a new technique that can be used for TMJ reconstruction [9]. In addition, according to the main principles of Ilizarov, transport distraction osteogenesis (TDO) is a distinctive technique for the reconstruction of neo-condyle in the craniofacial region [10]. The advantages of this technique include decreased morbidity rates and reduced operation time due to its use of TMJ function without using autogenous grafts or alloplastic material. Also, this technique avoids necessity of a secondary surgical site for harvesting autogenous grafts and therefore reduces donor site complications. Thus, this technique does not require patients who undergo surgery to restrict their TMJ movements in the postoperative latency period and elongation phase [9].

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This case report describes the reconstruction of three patients' ramus-condyle unit via the TDO technique, after tumoral bony mass resection.

2. Material and methods

2.1. Surgical and distraction technique

All patients underwent the operation technique described by Stucki-McCormick et al. [10]. The surgical protocol involved resection of the tumoral bone mass and involved the condylar neck and simultaneous reconstruction of the condyle ramus unit via TDO.

All cases were evaluated by radiologists and initial radiological diagnosis of all cases was compatible with the benign neoplasms of the condylar region. In the radiographic assessment, it appears that the lesions of our patients were well-demarcated, radiopaque masses. Bone destruction or erosion was not radiographically evident. Therefore, one-stage surgeries were planned.

All excised samples were evaluated for histopathologic assessment. Antimicrobial treatment was applied postoperatively for 1 week, and distraction of fragments was carried out after a 7-day latency period with the rate of 1 mm per day using a titanium single vector distraction device (304.705; Synthes CMF, West Chester PA, USA). Overcorrection was also slightly applied to achieve adequate increased ramal height to annihilate hemifacial discrepancies. Advancement of the transport segment was observed by routine radiographic evaluation including an orthopantomogram (OPG) during elongation phase. According to the increased ramal height, occlusal improvements were observed simultaneously. The elongation phase was discontinued when the mandibular dental midline was slightly driven out to the contralateral site. No additional physiotherapy or exercises were applied postoperatively or during the elongation phase.

Patients were followed up for 2 years and during the consolidation period that lasts for 6 months. The distractor device was used as a fixation device. The transport segment was remodeled to form a neo-condyle, and distractors were removed via preauricular and submandibular approaches after a bone-like radiopacity of the posterior ramus outline was provided radiographically.

Surgery outcomes were assessed by measuring the lateral and protrusive direction of jaw movements and the maximal mouth opening and by examining any dental malocclusion, anterior open bite, and posterior crossbite.

2.2. Histopathologic evaluations

All three bony lesions were excised intraoperatively, and the histologic assessment confirmed the clinical diagnosis of osteochondroma, condylar hyperplasia, and osteoma, which are rarely seen in the condylar area.

3. Cases

All three patients included in this paper had complaints of restricted mouth opening, facial asymmetry, and a contralateral site-deviated mandible and were admitted to our clinic between 2011 and 2012. The medical histories of all patients were uneventful.

3.1. Case 1

Patient 1 was a 47-year-old man admitted to our clinic. During the intraoral examination, it was revealed that there was 2-mm deviation of midline to the right side, and his maximum mouth opening was 14 mm. Also, a posterior crossbite was observed from the contralateral side of the mandible unilaterally. Lateral movements were slightly limited; however, no trismus was noted. His face was slightly asymmetric due to a tumoral bone mass that increased the left ramal height. In the radiographic assessment, a well-defined radiopaque bone-like mass that developed from the left condyle was determined. Patient 1 underwent distraction osteogenesis surgery for reconstruction of left TMJ, and after 6 postoperative months, the patient had a satisfactory mouth opening (40 mm). The phase of elongation was observed by radiographic assessment postoperatively (Fig. 1). Although lateral movement of the jaw to the contralateral site was returned to normal after 3 months, a mild anterior open bite could not be avoided. Patient 1 was admitted to prosthodontic treatment to adjust minimal persistent occlusal discrepancies after an initial neo-condyle remodeling phase. After 24 months postoperatively, patient 1 had a satisfactory facial symmetry and dental midline.

3.2. Case 2

Patient 2 was a 35-year-old woman. An initial intraoral examination revealed a posterior contralateral site crossbite with a slight deviation. The maximal mouth opening was 6 mm preoperatively, and the lateral movement of TMJ to the left was restricted. Also, an edge-to-edge dental occlusion was noted. Two years before, the patient had noticed that she experienced restriction while opening her mouth, and this situation became worse progressively with time. Due to the increased ramal height of the left side, facial asymmetry and crossbite concomitantly occured in the right premolar-canine region. The OPG showed a well-demarcated radiopaque area located in the left condylar region. After surgery, patient 2 also had an uneventful postoperative period. The maximum mouth opening was 44 mm after 3 months postoperatively, and lateral jaw movements were satisfactory. However, due to premature contact of the left, second premolar teeth accompanied with habitual bruxism, the patient had mild sensitivity in the left masticatory region. Although the formed neo-condyle was not located in the glenoid fossa, even after the primary remodeling phase, satisfactory outcomes were achieved (Fig. 2).

3.3. Case 3

Patient 3 was a 27-year-old man that underwent condylectomy surgery 1 year before in another ENT clinic due to the chief complaint of restricted jaw movements and dental malocclusion. His first complaints were induced with an accompanied progressive growth of the bony tumor originating from the right condylar process. Although a symmetric facial appearance was noted, a dental midline deviation to the ipsilateral site was clinically evident; also, decreased ramal height resulted in a posterior mandibular crossbite at the ipsilateral site and a posterior open bite at the contralateral site simultaneously. After an initial tumor-removal surgery without distraction osteogenesis, his complaints were diminished; however, improved or reduced anterior crossbite was not achieved clinically. After the distraction osteogenesis surgery was carried out, outcomes of the surgery were insufficient due to a persistent postoperative infection (Fig. 3). Although subsequent condylar healing was poor, the patient experienced no discomfort after treatment.

4. Discussion

Temporomandibular condyle reconstruction via transport distraction osteogenesis (TDO) was first described by Stucki-McCormick et al. [10]. In that study, the main principles of surgical

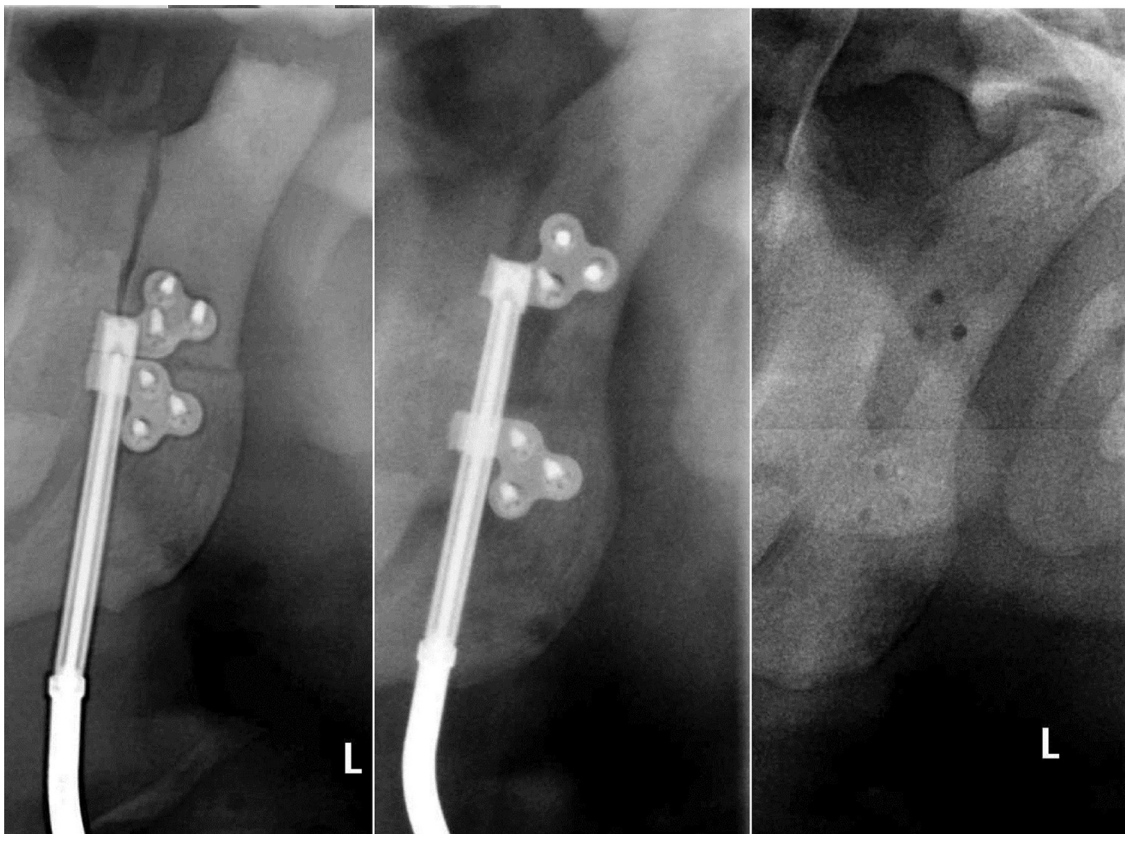

Fig. 1. The elongation phase of patient 1. The orthopantomogram after the distractor removal showing the proper position of the condyle and glenoid fossa with mild eminence resorption due to remodeling (from left to right).

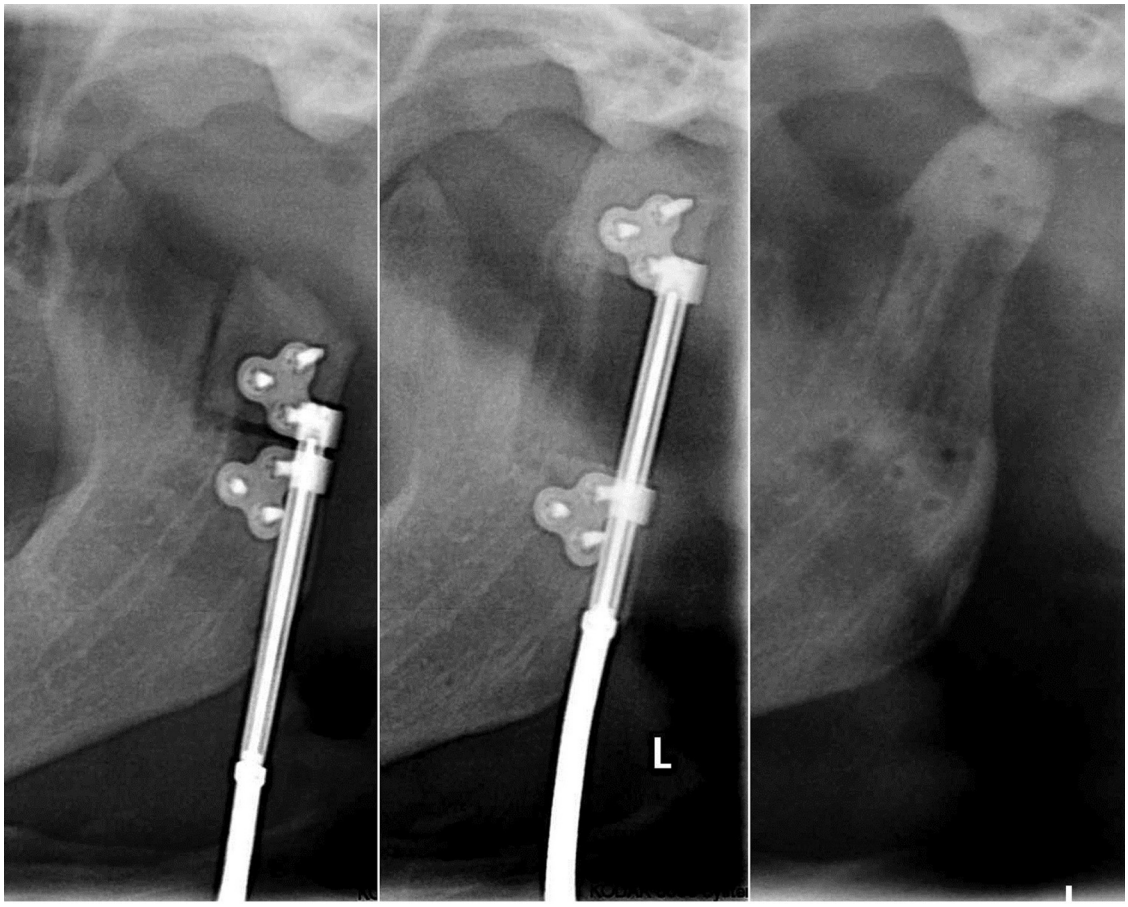

Fig. 2. The reverse L osteotomy and fixed distractor device. The elongation phase of patient 2 and the orthopantomogram of the remodeling phase (from left to right).

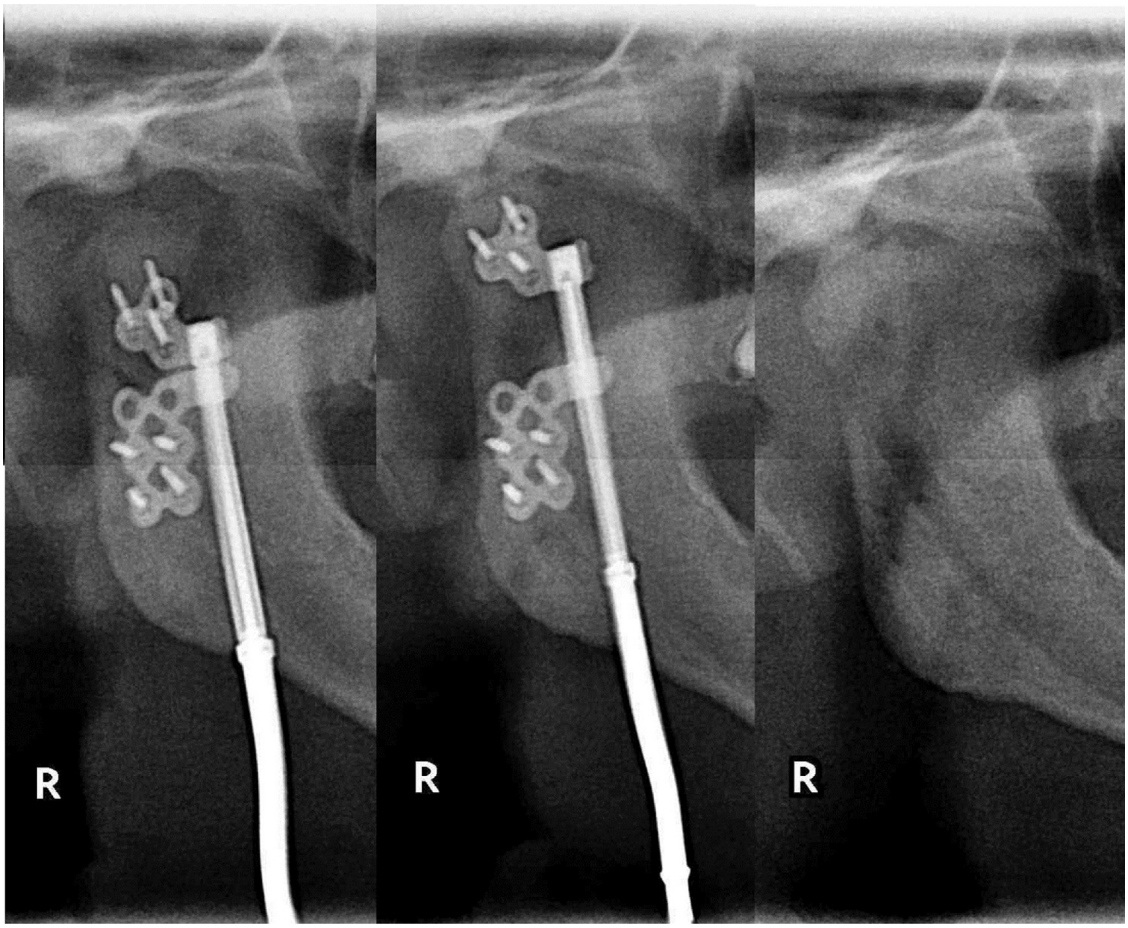

Fig. 3. The elongation phase of patient 3. Neocondylar resorption was observed due to an infection (from left to right).

approach were demonstrated. A surgically created and moved superior transport disc was used to increase ramal height and created a reconstructed neo-condyle via an extraoral approach [10]. In the literature, subsequent animal and human studies confirmed the clinical and biological success of this technique [11–14].

Hikiji et al. [13] suggested that although cartilaginous tissues were predominant in the early phase of the distraction in the distraction gap, the gap was gradually filled with the new bone formation. This result suggests that endochondral ossification occurred in the distraction gap. Clinically, this condition can be encountered by radiographic assessment of the distal border of the newly formed mandible ramus. Gradually increased radiopacity of the distraction gap distal border can be examined in subsequent phases of gap healing. Hikiji et al. [13] also observed new bone formation at the distal surface of the transport segment via intramembranous ossification.

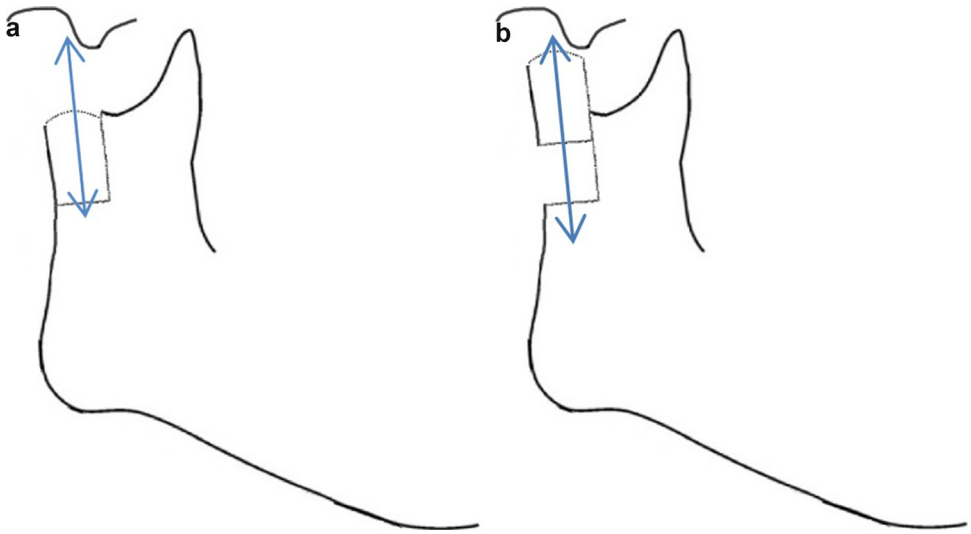

Fig. 4. a Condylectomy with resection of the condylar neck. **b**According to the insufficient anteroposterior ramus length; premature contact of the transport segment and posterior eminence.

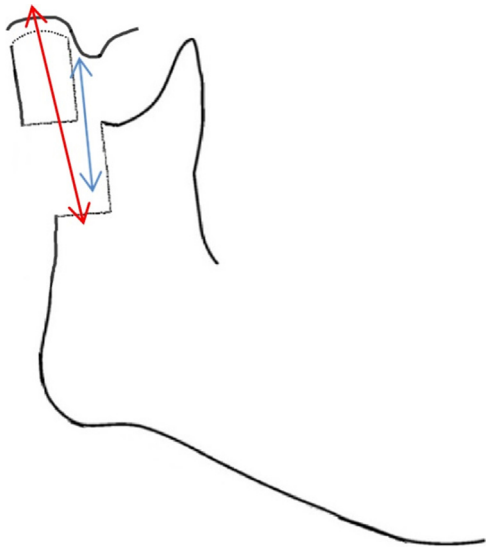

Fig. 5. For such particular cases, it seems that adjusting the distraction vector slightly posterior to provide the transport segment in glenoid fossa respectively (red arrow).

Zhu et al. [12] noted that neo-condyles resembled a native condyle at 12 weeks after the elongation phase, and according to continuous condyle remodeling, the upper part of the transport segments delineated an oval shape in 24 weeks postoperatively in an experimental animal model. Also, a fibrous cap was observed superiorly covering reconstructed neo-condyles at 12 and 24 weeks postoperatively via histologic assessment in that study. Zhu et al. [12] suggested that the reconstructed neo-condyles had similar functional and histologic capabilities to native condyles.

Tuzuner-Oncul and Kisnisci [14] reported a human study with eight adult patients and suggested that the gained vertical ramus height via condylar transport distraction osteogenesis was stable, and no relapse was observed at 2-year-follow up. However, in the present case report, it seems that bone remodeling continues even after for 2 postoperative years. The result of this process can be observed clinically by evaluating the dental midline deviation at the ipsilateral site in routine intervals. Therefore, we applied prosthetic rehabilitation to one patient to overcome these mild occlusal discrepancies. A prolonged consolidation phase before removing the distraction device may diminish this unfavorable condition.

Mehrotra et al. [11] reported eight patients who underwent surgery for reconstruction of the condylar process via transport distraction osteogenesis. Precise preoperative assessments and correct vector direction measurements were crucial for creating successful treatment outcomes. In the present cases, we applied reverse L osteotomy, which is similarly described by Stucki-McCormick et al. [10]. Transport discs were superiorly moved as planned; however, in case 2, the created transport segment was not located in the glenoid fossa due to premature contact to the posterior border of the articular eminence. This unexpected result did not compromise the clinical outcomes.

In our opinion, this condition is related to applying the level of condylectomy intraoperatively. Condylectomy can be applied either with resection or by preserving condylar neck. The former may be lead to premature contact in the beginning of the elongation phase, due to the readily shorter anteroposterior length of the native ramus in the alignment of the transport segment's superior aspect (Fig. 4a–b). According to our experience, distractor device vectors can be adapted slightly posterior to gain more length in the axial plane while distracting transport segment to glenoid fossa in these kinds of patients individually (Fig. 5). However, we did not encounter complications related to the latter. Therefore, it is unnecessary to gain additional length posteriorly in the axial plane; adequate vector determination is simple theoretically (Fig. 6a–b). As a result, condylar reconstruction via TDO while simultaneously preserving the condylar neck can be considered a more reliable approach.

Technical complications of distraction osteogenesis include regenerate disorders, soft tissue overstretching, segmental deviations and infections. Neelakandan and Bhargava [15] reported that common complications of TDO include transport segment deviation, early consolidation, postoperative infection and device exposure, according to 20 cases. In that study, the reported infection incidence in straight mandibular regeneration was 60% and in multivectoral regeneration, the incidence was 40%. Among our cases, only patient 3 had infection postoperatively. Although antimicrobial therapy was applied, transport segment resorption was revealed in the consolidation phase, depending on the persistent infection. Subsequently, patient 3 had no persistent pain, purulent drainage or discomfort.

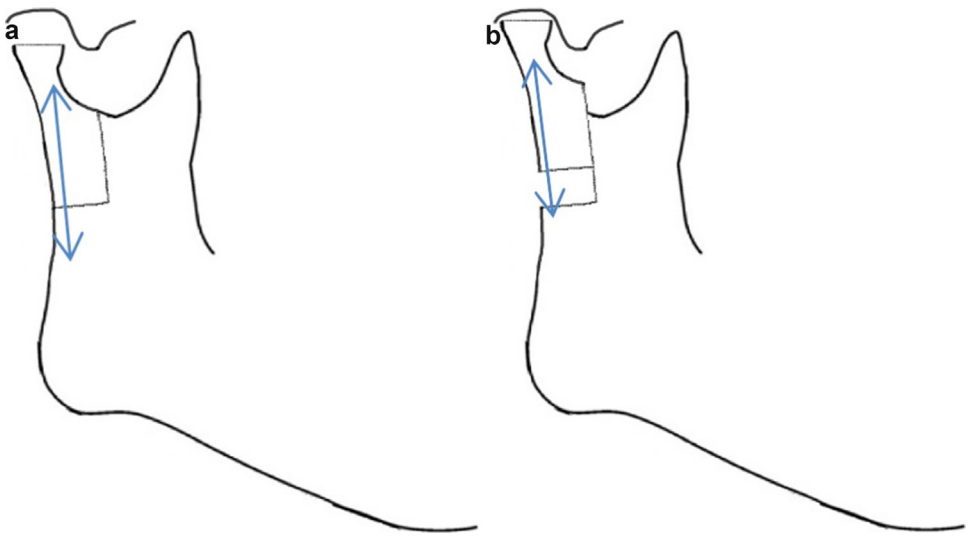

Fig. 6. a After condylectomy applied with preserving the condyle neck; it is unnecessary to gain additional lenght in the axial plane. **b**Parallel distraction vector adjustment to the ramus posterior border is reliable for transporting the segment to glenoid fossa while preserving the condylar neck.

5. Conclusion

The condylar transport distraction osteogenesis technique provides successful outcomes for TMJ reconstructions. Although there were minor postoperative complications, minor adjustments may be applied intraoperatively and/or postoperatively to overcome these complications. Further prosthodontic rehabilitation and intraoperative determination of an adequate distraction vector are particularly crucial for ensuring successful outcomes.

Disclosure of interest

The authors declare that they have no competing interest.

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