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*Article*

# Management of temporomandibular joint ankylosis in Yemeni children by metatarsal bone grafts.

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Abstract: Aim: This study aimed to evaluate temporomandibular joint reconstruction in Yemeni children with metatarsal bone graft after release of ankylosis. Methodology: Ten patients ≤12 years of age, comprising eight unilateral and two bilaterally TMJ ankylosis, were selected for this study. These patients underwent reconstruction with 10 non-vascularized metatarsal grafts. The reconstructed joints were then followed for an average of 1 year. Measures of opening, symmetry, and clinical symptoms relating to the reconstructed joints were assessed. Results: Mean pre-operative interincisal aperture was 8.2mm, and immediate post-operative aperture 23.4mm. At the end of the follow-up period, acceptable results were achieved in 8 out of 10 cases, with adequate mouth opening of 35.6mm in 8 out of 10 patients and overall interincisal aperture of 30.3mm. Re-ankylosis occurred in two bilaterally-treated patients at the end of follow-up. Subjectively, 80% of the patients rated their function as satisfactory and were able to occlude and masticate without any difficulty. Conclusion: Reconstruction of TMJ after release of ankylosis utilizing metatarsal bone graft shows a satisfactory interincisal aperture in 80% of patients.

*Keywords: Temporomandibular ankylosis; pediatric patient; surgery; metatarsal graft; Yemen.*

**Conflict of interests:** None.

**Ethics approval:** The present study was approved by the Medical Ethics Committee of the Collage of Dentistry at University of Science and Technology, Sana'a, Yemen (Ethics No.: 2016/21).

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## INTRODUCTION.

The temporomandibular joint (TMJ) is one of the most important joints in the human body. However, its ankylosis can impair mandibular growth and function, which may later produce a severe facial asymmetry and mandibular retrusion. Furthermore, TMJ ankylosis causes an impairment of orofacial function that may include limited chewing ability, impaired speech, compromised oral hygiene, restricted airway problems and impeded mandibular molar eruption.[1]

TMJ ankylosis that develops in childhood in particular has its own characteristics,which influence the growth and development of the mandible causing a bird-face appearance in bilateral cases, and deviations towards the affected side appear in unilateral cases. In addition, as the result of insufficient nutrition, the children's development remains behind their counterparts.[2-4]

The most common cause of TMJ ankylosis is trauma or infection. The incidence of TMJ ankylosis due to trauma ranges from 26% to 75%. Even though occurrence of this problem as a result of infection


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has ranged from 44% to 68%, this percentage has recently decreased due to antibiotic therapy.[4-11]

Surgical treatment of TMJ ankylosis depends on the extent and type, age of the patient, onset and time of surgery, and whether the ankylosis is unilateral or bilateral. However, the type of operation and treatment policy vary between countries. There are several ways of reconstructing the TMJ, such as autogenous (fibula, clavicle, sternoclavicular joint, iliac bone, metatarsal bone and metatarsal-phalangeal joint),[11-21] and alloplastic methods.

Metatarsal bone graft can provide a good supply of articular cartilage because it is composed of articular cartilage and bone fitting anatomy and due to small size it has potential for growth. The risk of degeneration and re-ankylosis of the graft is low, especially when used as a vascularized graft. Furthermore, there is an acceptable cosmetic result at the donor site, which can be well hidden.[13]

Surgeons' decisions regarding the selection of materials and techniques are made difficult by the number of available options. Moreover, related literature points out the lack of accepted clinical standards and consensus regarding the optimal way of reconstructing the TMJ. Furthermore, there is no agreement about the ideal materials and techniques for reconstructing the TMJ.[11]

In Yemen, no study has yet evaluated the TMJ joint reconstruction after the release of ankylosis. Therefore, the present study aimed to assess TMJ reconstruction in Yemeni children with metatarsal bone graft after releasing ankylosis.

## MATERIALS AND METHODS.

### Patient selection

The Scientific Committee of the Dental College at the University of Science and Technology at Sana'a (Yemen) approved this study (Ethics No.: 2016/21). Patient anonymity was strictly respected in all cases. The sample consisted of patients seeking treatment for TMJ ankylosis at University of Science and Technology Hospital, Sana'a, Yemen.

All subjects, which agreed to participate in this study, were examined clinically and radiographically. Of these, patients with true fully or partially bony or fibrous TMJ ankylosis were included in this study.

However, subjects with pseudo-ankylosis (ankylosis due to problems outside the temporomandibular joint) or interincisal opening exceeding 20mm were excluded from the study. Additionally, subjects with previous treatment of TMJ ankylosis were also excluded. The final sample was composed of 10 patients aged ≤12 years, selected for this study according to the inclusion/exclusion criteria.

### Surgical procedure

The patients received surgical treatment from May 2013 to February 2016. The surgical operations were performed under general anesthesia via nasotracheal endoscopy or tracheostomy. The surgical procedure was carried out in four steps, namely, skin incision, release of the ankylosed condyle, preparation of the metatarsal bone graft and fixation of the graft in place.

The surgical incision was accomplished by creating an incision in a preauricular skin crease that is extended up to the temporal region superiorly to expose the condylar region, and the temporalis muscle. Incision is carried out through the skin and subcutaneous tissue to the depth of the temporalis fascia. The temporalis fascia is a glistening white tissue layer that is best appreciated in the superior portion of the incision.

Afterwards, the zygomatic arch and lateral pole of the mandibular condyle were palpated. Dissection was carried out inferiorly in a sub-periosteal plane to reach the neck of the mandibular condyle as the mandibular condylar region was reached; release of the ankylosed condyle was then started.

The ankylosed condyle was resected with a surgical bur in which a 10 to 15mm gap was created and initial interincisal opening was assessed.

Surgical treatment at the donor site consisted of harvesting the 2$^{nd}$, 3$^{rd}$ or the 4$^{th}$ metatarsal graft with its attached cartilage. With the help of a plastic surgeon, the 2$^{nd}$, 3$^{th}$ or 4$^{th}$ metatarsal bone graft with its attached cartilage was detached. Length of the graft varied in the 10 cases depending on the correction of the vertical height of the ramus. The periosteum at the donor site was then replaced and the wound closed in layers (Figure 1).

After that, the graft was shaped in its inferior border and reduced to match the ramus of the mandible. At

this time, occlusion is checked and the graft length is adjusted accordingly.

Access to and preparation of the recipient site was made through surgical site. Decortications of stump and the superior border of the ramus of the mandible were then carried out.

After reduction of the temporal bone with a bur to accommodate the bony stump the metatarsal graft is affixed to the mandibular body. The graft was seated in place and fixed with mini plates and screws (Figure 2). Initial mouth opening was then assessed. The wound was closed with VICRYL 3/0 for cutaneous and subcutaneous tissues and PROLENE 4/0 for skin.

### Postoperative care.

The presence or absence of infection sinus/fistula or dehiscence at the surgical site, inter incisal opening, facial nerve palsy as well as surgical scar were evaluated for donor and recipient sites in the third day of the operation. Diclofenac sodium was prescribed after surgery according to age and body weight, four times a day for five days (GSK Pharma, UK), as well as amoxicillin/clavulanic acid according to age and body weight, three times a day for five days (GSK Pharma, UK). Sutures were then removed after 7–10 days. Soft diet was recommended for 6 weeks post-operatively. It was also recommended that patients avoid hard food or trauma to the surgical site.

### Follow-up examination

A panoramic radiography and a CT-scan were obtained to evaluate the release level of TMJ ankylosis immediately after surgery. The position, growth and resorption of the metatarsal bone graft were evaluated. Patients were investigated clinically and radiographically at intervals of immediately, 10 days, 3, 6 and 12 months post-operatively. During each visit, the clinical assessment of mouth opening level was respectively conducted by a surgeon, who was involved in the treatment of the patients.

### Statistical Analysis

The analysis of the data was performed using SPSS 21.0 for Windows (SPSS Inc., Chicago, IL, USA). The repeated measure one way ANOVA and multiple comparisons (Bonferroni) were used to determine statistical significance between interincisal apertures pre-operatively and post-operatively. The significance level was set at $p<0.05$.

**Figure 1**. Metatarsal graft.

**Figure 2**. Metatarsal graft seated in place and fixed with mini plates and screws.


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## RESULTS.

The main etiological factor for ankylosis was trauma in nine patients and infection in only one case. In all patients, mean pre-operative maximum interincisal opening (MIO) was 8.2mm (Table 1).

Post-operative radiographs at the time of discharge show that the metatarsal joint was well positioned in the glenoid fossa. There was stable fixation in all cases as demonstrated by radiographical and clinical examinations. Bone contact between the temporal eminence, the metatarsal and the mandibular body was correctly achieved.

Immediately, mean post-operative MIO was 23.4mm. At end of follow-up, satisfactory results was seen in 8 out of 10 cases. Inter-operative bleeding was mild to moderate and none of the patients required blood transfusion inter- or post-operatively. Three cases lost the ability to wrinkle the forehead, which returned to normal after 1-3 months. No facial palsy was noted after surgery, all the patients smiled symmetrically. A complete characterization of patient sample is shown in Table 1.

There was a statistically significant change in MIO over time ($p$=0.017), comparisons with immediate MIO are shown in Table 2.

**Table 1**. Characterization of patient sample.

| Age | Etiology | Side involved (sides) | Pre-operative MIO (mm) | Immediate post-operative MIO (mm) | MIO after 10 days (mm) | MIO after 3 months (mm) | MIO after 6 months (mm) | MIO after 12 months (mm) | Radiography at 1 year | Facial nerve injury |
|---|---|---|---|---|---|---|---|---|---|---|
| 6y | Trauma | Both | 2 | 16 | 16 | 20 | 25 | 8 | Re-ankylosis | Recovered after 3m |
| 7y | Trauma | Both | 6 | 15 | 15 | 18.5 | 21 | 10 | Re-ankylosis | Recovered after 3m |
| 2y | Infection | Right | 4 | 15 | 18 | 25 | 30 | 36 | No ankylosis | None |
| Infant | Trauma | Right | 3 | 20 | 20 | 23 | 35 | 37 | No ankylosis | None |
| 10 y | Trauma | Left | 10 | 25 | 20 | 22 | 32 | 32 | No ankylosis | None |
| 4y | Trauma | Right | 4 | 20 | 15 | 16 | 35 | 38 | No ankylosis | None |
| 12y | Trauma | Left | 8 | 25 | 26 | 21 | 31.5 | 35 | No ankylosis | None |
| 4y | Trauma | Left | 12 | 30 | 30 | 32 | 33 | 35 | No ankylosis | None |
| 5y | Trauma | Right | 16 | 30 | 32 | 35 | 35 | 35 | No ankylosis | None |
| 6y | Trauma | Right | 17 | 28 | 28 | 30 | 37 | 37 | No ankylosis | Recovered after 1m |

**Table 2**. Mean MIO at different times.

| Follow-up period | Mean | Std. Error | 95% Confidence Interval | | $p$-value |
|---|---|---|---|---|---|
| | | | Lower Bound | Upper Bound | (comparison with immediate MIO) |
| Immediate | 22.400 | 1.351 | 19.285 | 25.515 | - |
| After 10 days | 22.000 | 1.572 | 18.376 | 25.624 | 1.000 |
| After 3 months | 23.950 | 1.727 | 19.968 | 27.932 | 1.000 |
| After 6 months | 31.450 | 1.337 | 28.367 | 34.533 | 0.001 |
| After 1 year | 30.300 | 3.231 | 22.849 | 37.751 | 0.264 |

## DISCUSSION.

TMJ ankylosis is a serious and disabling condition. Speech impairment, difficulty with mastication, rampant caries and poor oral hygiene, disturbances of facial and mandibular growth, and acute compromise of the airway invariably results in physical and psychological disability. This is particularly true of young children who are completely unable to open their mouth.[21]

The treatment of TMJ ankylosis should start as soon as the condition is recognized to minimize the restriction of

facial growth.[21,22] There are three basic surgical objectives in the treatment of TMJ ankylosis. These are to establish joint movement, to prevent relapse and to achieve normal growth and development.

Treatment of true ankylosis of the TMJ is surgical. One of the surgical methods is condylectomy, but it has lost its popularity as it is technically difficult to release the fused remnants of the condylar head exactly at the joint space[23] and that re-ankylosis is not rare.[24,25]

Various methods as interpositional arthroplasty, alloplastic or biological materials are interposed between the divided bone ends.[23,25] At the beginning, stainless steel, chrome-cobalt, etc., were used for interposition, but later silicone blocks and porous proplast-teflon were popularized.[25] Alloplastic materials preserve the vertical height of the ramus. However, due to implant replacement, malocclusion may develop.[25] Allergic reactions, foreign body reactions, and erosion of the glenoid fossa are the other complications.[23,25] It is also an expensive method and must not be used in growing patients.[25]

The use of biological materials such as fascia lata and muscle or dermal fat graft may not preserve the vertical height of the mandibular ramus, therefore retrognathia, apertognathia, laterognathism, and open-bite deformity may develop.[23] Many reports have documented the rationale for the use of costochondral graft in reconstruction of the TMJ; however, pneumothorax and perichondritis may occurr.[13,26] In the present study, the metatarsal bone graft was used because of its biological compatibility, workability, functional adaptability, and minimal additional detriment to the patient.[27]

In the present study, acceptable results were found in 8 out of 10 cases using metatarsal bone grafts for the reconstruction of the joint after resection of the ankylosed joint, with adequate mouth opening of 35.6mm. These findings are consistent with those of Sharma *et al.,*[21] In their study, satisfactory results were achieved in 8 out of 10 cases, with sufficient mouth opening of 35mm in 8 subjects. However, the findings of the current study (35.6mm) were lower than reported by Landa *et al.,*[28] who showed that the post-operative interincisal aperture was 48.5mm. This is probably due to non-vascularized metatarsal joint grafts being used in the present study; however, Landa *et al.,*[28] used vascularized second metatarsal joint grafts.

In this study, re-ankylosis was seen in two cases which may be due to lack of adequate physiotherapy and the patients were lost to proper follow-up. The findings of the present study agree with Buncke *et al.*,[27] who noticed that severe degenerative changes and re-ankylosis occurred in two patients. Furthermore, most authors agree that recurrence of ankylosis is less likely when something is interposed between the two cut bony surfaces.[21,29]

Topazian[29] compared gap and interpositional arthroplasties and reported 53% incidence of recurrence, when the gap arthroplasty method was used without interposition. Therefore, interpositional arthroplasty involves creation of a gap, but in addition a barrier (autogenous or alloplastic) was inserted between the cut bony surface to minimize the risk of recurrence and to maintain the vertical height of the ramus. In the current study the ankylosed condyle was resected with a surgical bur in which a 10 to 15mm gap is achieved by gap arthroplasty. Ma *et al.,*[12] recommended using wide surgical exposure and complete resection of ankylosis and the use of appropriate interposition materials to prevent re-ankylosis. Interpositional arthroplasty is an improvement of gap arthroplasty that involves the insertion of interpositional materials (autogenous and alloplastic) into the space created by gap arthroplasty to prevent re-ankylosis.

Liu *et al.,*[19] showed that interpositional gap arthroplasty was more effective and displayed a lower recurrence rate, followed by joint reconstruction and gap arthroplasty, in treating TMJ ankylosis. However, Danda *et al.,*[30] did not find significant differences in the MIO and incidence of re-ankylosis between the patients who underwent gap arthroplasty and those who received interpositional arthroplasty, and concluded that the success of treatment depended on patient cooperation, active physiotherapy, and regular follow-up. This supported the current findings that re-ankylosis in two cases may be due to lack of adequate physiotherapy.

Facial nerve injury only occurred at the time of harvesting the metatarsal grafts in three cases, who lost the ability to wrinkle the forehead. However, the issue resolved within less than 4 months.

## CONCLUSION.

Reconstruction of TMJ after release of ankylosis utilizing metatarsal bone graft shows a satisfactory interincisal aperture in 80% of patients.


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## REFERENCES.

1. Sporniak-Tutak K, Janiszewska-Olszowska J, Kowalczyk R. Management of temporomandibular ankylosis--compromise or individualization--a literature review. Med Sci Monit. 2011;17(5):RA111–6.
2. Mishu SM, Hasan N, Hossain A, Jabbar S. Management of juvenile temporo-mandibular joint ankylosis by gap arthroplasty. Update Dent Coll J. 2014;4(1):46–50.
3. Mabongo M. Temporomandibular joint ankylosis in children. IOSR J Dental Med Sci. 2013;12:35–41.
4. Cho JW, Park JH, Kim JW, Kim SJ. The sequential management of recurrent temporomandibular joint ankylosis in a growing child: a case report. Maxillofac Plast Reconstr Surg. 2016;38(1):39.
5. Arakeri G, Kusanale A, Zaki GA, Brennan PA. Pathogenesis of post-traumatic ankylosis of the temporomandibular joint: a critical review. Br J Oral Maxillofac Surg. 2012;50(1):8–12.
6. Bello SA, Aluko Olokun B, Olaitan AA, Ajike SO. Aetiology and presentation of ankylosis of the temporomandibular joint: report of 23 cases from Abuja, Nigeria. Br J Oral Maxillofac Surg. 2012;50(1):80–4.
7. Li JM, An JG, Wang X, Yan YB, Xiao EL, He Y, Zhang Y. Imaging and histologic features of traumatic temporomandibular joint ankylosis. Oral Surg Oral Med Oral Pathol Oral Radiol. 2014;118(3):330–7.
8. Yan YB, Duan DH, Zhang Y, Gan YH. The development of traumatic temporomandibular joint bony ankylosis: a course similar to the hypertrophic nonunion? Med Hypotheses. 2012;78(2):273–6.
9. Yan YB, Zhang Y, Gan YH, An JG, Li JM, Xiao E. Surgical induction of TMJ bony ankylosis in growing sheep and the role of injury severity of the glenoid fossa on the development of bony ankylosis. J Craniomaxillofac Surg. 2013;41(6):476–86.
10. Yan YB, Liang SX, Shen J, Zhang JC, Zhang Y. Current concepts in the pathogenesis of traumatic temporomandibular joint ankylosis. Head Face Med. 2014;10:35.
11. Khadka A, Hu J. Autogenous grafts for condylar reconstruction in treatment of TMJ ankylosis: current concepts and considerations for the future. Int J Oral Maxillofac Surg. 2012;41(1):94–102.
12. Ma J, Liang L, Jiang H, Gu B. Gap Arthroplasty versus Interpositional Arthroplasty for Temporomandibular Joint Ankylosis: A Meta-Analysis. PLoS One. 2015;10(5):e0127652.
13. Muralee MC, Prasad BR, Bhat S, Bhat SS. Reconstruction of condyle following surgical correction of temporomandibular joint ankylosis:current concepts and considerations for the future. NUJHS. 2014;4(2):39-46.
14. Katsnelson A, Markiewicz MR, Keith DA, Dodson TB. Operative management of temporomandibular joint ankylosis: a systematic review and meta-analysis. J Oral Maxillofac Surg. 2012;70(3):531–6.
15. Holmlund A, Lund B, Weiner CK. Mandibular condylectomy with osteoarthrectomy with and without transfer of the temporalis muscle. Br J Oral Maxillofac Surg. 2013;51(3):206–10.
16. Mansoor N, Khan M, Mehboob B, DIN Q. GAP vs Interpositional arthroplasty in the management of temporomandibular joint ankylosis. Pak Oral Dent J. 2013;33(1):8–12.
17. Shaikh SK, Mishra M, Tiwari AK, Chander M, Gaur A, Singh H. Comparative evaluation of gap arthroplasty and interpositional arthroplasty using temporalis fascia in the management of temporomandibular joint ankylosis. J Orofac Res. 2013;3(3):170–4.
18. Bhatt K, Roychoudhury A, Bhutia O, Pandey RM. Functional outcomes of gap and interposition arthroplasty in the treatment of temporomandibular joint ankylosis. J Oral Maxillofac Surg. 2014;72(12):2434–9.
19. Liu X, Shen P, Zhang S, Yang C, Wang Y. Effectiveness of different surgical modalities in the management of temporomandibular joint ankylosis: a meta-analysis. Int J Clin Exp Med. 2015;8(11):19831–9.
20. Sidebottom AJ. Alloplastic or autogenous reconstruction of the TMJ. J Oral Biol Craniofac Res. 2013;3(3):135–9.
21. Sharma H, Chowdhury S, Navaneetham A, Upadhyay S, Alam S. Costochondral Graft as Interpositional material for TMJ Ankylosis in Children: A Clinical Study. J Maxillofac Oral Surg. 2015;14(3):565–72.
22. Adekeye EO. Ankylosis of the mandible: analysis of 76 cases. J Oral Maxillofac Surg. 1983;41(7):442–9.
23. Zhu S, Wang D, Yin Q, Hu J. Treatment guidelines for temporomandibular joint ankylosis with secondary dentofacial deformities in adults. J Craniomaxillofac Surg. 2013;41(7):e117–27.
24. Movahed R, Mercuri LG. Management of temporomandibular joint ankylosis. Oral Maxillofac Surg Clin North Am. 2015;27(1):27–35.
25. McBride KL. Total Temporomandibular Joint Reconstruction. En: Bell, W.H. Modern Practice in Orthognathic and Reconstructive Surgery. Philadelphia: WB. Saunders; 1992.
26. Passi D, Singh G, Singh S, Mehta G, Dutta S, Sharma S. Advances in temporomandibular joint reconstruction in TMJ ankylosis: Our experiences and literature review. Int J Dent Res. 2014;2(2):45–9.
27. Buncke HJ Jr, Daniller AI, Schulz WP, Chase RA. The fate of autogenous whole joints transplanted by microvascular anastomoses. Plast Reconstr Surg. 1967;39(4):333–41.
28. Landa LE, Gordon C, Dahar N, Sotereanos GC. Evaluation of long-term stability in second metatarsal reconstruction of the temporomandibular joint. J Oral Maxillofac Surg. 2003;61(1):65–71.
29. Topazian RG. Etiology of Ankylosis of Temporomandibular joint: Analysis of 44 cases. J Oral Surg Anesth Hosp Dent Serv. 1964;22:227–33.
30. Danda AK, SR, Chinnaswami R. Comparison of gap arthroplasty with and without a temporalis muscle flap for the treatment of ankylosis. J Oral Maxillofac Surg. 2009;67(7):1425–31.