Position of Titanium Condylar Prosthesis for Replacement of Condylar Disarticulation in Ameloblastoma Patient

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Abstract

Mandibular resection with disarticulation of condyle required reconstruction using plates and temporomandibular joint (TMJ) prosthesis to improve function and form, reduce suffering, contain excessive treatment, and prevent further morbidity. Accurate placement of condylar should be maintained for functioning in the glenoid fossa.

To evaluate condylar prothesis position for replacement of condylar disarticulation in ameloblastoma patient Methods : Retrospective cohort study was conducted in this study. Position of the prosthetic condylar head in 21 patients were evaluated for intercondylar distance, and vertical and lateral displacement was measured on sagittal and coronal computerized tomography (CT) scans for preoperative compared to CBCT scans for post-operative.

Highest preoperative intercondylar measurement was at 102.70 mm and lowest at 89.33 mm. For horizontal measurement in the preoperative scan, patient 3 has the highest measurement at 9.38 mm meanwhile lowest is found in patient 7 with 4.38 mm. For post-operative scan in horizontal measurement, patient 8 has the highest measurement at 10.90 mm, meanwhile, the lowest is in patient 7 with 4.11 mm. The result for vertical measurement in the preoperative scan showed the highest value in patient 8 at 6.55 mm and the lowest in patient 6 at 2.05 mm.

Titanium condylar prosthesis could be considered as a temporary condylar prosthesis, its ability to replace the position and function of the disarticulated condyle in ameloblastoma patients showed a satisfactory result.

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Introduction

Ameloblastomas are benign tumours characterized by an aggressive potential for local invasion and a high recurrence rate, requiring a precise histological diagnosis and surgical treatment.[1,2] Surgical resection of the mandible with ameloblastoma is the preferred option, cutting the margin over healthy bone is required to reduce the risk of recurrent since ameloblastoma cells have the ability to grow further than bone lesion margin appeared.[3,4] For the posterior area especially in the lesion nearby the temporomandibular joint, a disarticulation of the condyle is inevitable.[5,6]

Mandibular resection with disarticulation of condyle required reconstruction using plates and temporomandibular joint (TMJ) prosthesis.[7] The goals of TMJ reconstruction in a patient with a disarticulated condyle are to improve function and form, reduce suffering, contain excessive treatment, and prevent further morbidity.[8] Titanium condyle prosthesis is an option that closely mimics the form and function of the original joint it replaces the titanium condylar prosthesis is a temporary condyle made of medical-grade titanium for TMJ reconstruction. It is produced by implant manufacturers as stock implants with several general sizes and shapes as shown in Figure 1.[5] Titanium condyle prosthesis will provide an immediate functional reconstruction without donor-site morbidity.[9]

Accurate placement of these condylar prostheses is required to avoid complications. The position should be maintained for functioning in the glenoid fossa during the immediate postoperative period and the long-term functional

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period. Finally, several reports in the literature have described a wide range of complications including persistent pain, erosion into the external auditory meatus, erosion into the middle cranial fossa, migration, fracture of the prosthesis, and plate exposure.[10] Evaluation of condyle prosthesis should be done to decide if further surgical revision is required and predict future outcomes.

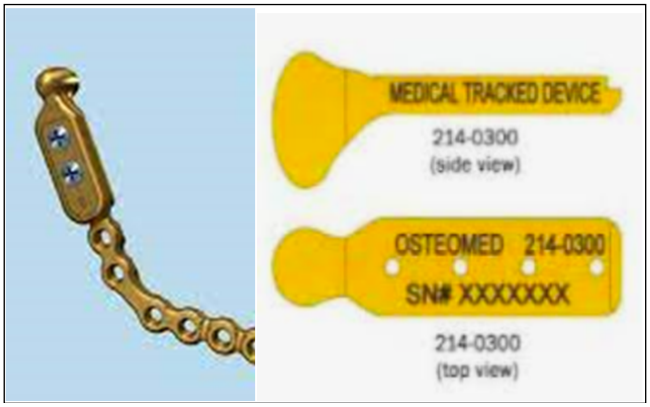

Figure 1. Titanium condylar prosthesis attached to 2.4 reconstruction plate to simulate condylar in superior mandible ramus. b. temporary condyle attachment made by Osteomed with shape and contour simulating condyle bone with 4 holes for screw available in the inferior part of condyle prosthesis.(source : https://synthes.vo.llnwd.net/ and https://www.acumed.net/wp-content/uploads/2021/11/OsteoMed-CMF-Catalog-030-1350-B.pdf)

Materials and methods

We conducted a retrospective cohort study to address the research hypothesis. The study was approved by the institutional ethical board at the Faculty of Dentistry, Universitas Indonesia. The study population included all patients presenting to the Oral and Maxillofacial Surgery Department, Ciptomangunkusumo Hospital - Universitas Indonesia, requiring reconstruction of the mandibular and condyle prosthesis placement between 2020 and 2021. The variable factor of this study was the accurate positioning of the titanium condylar prosthesis compared with the native preoperative condyle. The position of the prosthetic condylar head was evaluated in all patients for intercondylar distance, and vertical and lateral displacement was measured on sagittal and coronal computerized tomography (CT) scans for preoperative compared to CBCT scans for post-operative, respectively, using the same calibrated measurement software tool.

For intercondylar distance, measurement is done by measuring from one point the most superior condyle margin to another point on another side of the most superior margin of the condyle and for post-operative patients will be measured on the most superior of the condylar prosthesis as illustrated on Figure 2a.[11] For vertical displacement measurement, the most superior portion in the glenoid fossa was used as the superior point of reference, and the distance between this superior point and the condylar head was measured (Fig 2b).[10] Similarly, for lateral displacement measurement, the petrotympanic fissure was used as the medial point of reference. The distance between this medial point and the centre of the condylar head margin was then measured to represent the lateral position of the condyle (Fig 2c). These vertical and horizontal measurements of the condylar prosthesis were then compared with the preoperative native condylar position (vertical and lateral positioning from the same reference points on the same side of the preoperative condition).

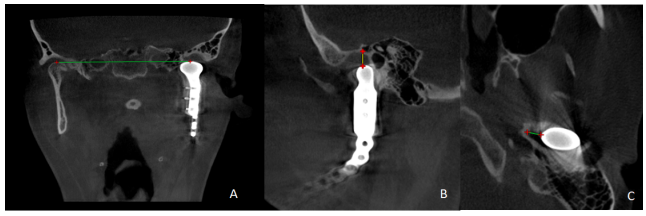

Figure 2 a. Measurement for intercondylar distance in coronal view of 2D slice scan. **b.** Measurement for a vertical distance of condyle in sagittal view of 2D slice scan. **c.** Measurement for a horizontal distance of condyle in the axial view of 2D slice scan. (source: private pic docs).

Patient inclusion for this research has to fulfil criteria as follows: Patients with ameloblastoma that require surgical resection on one side of the mandibular bone up to condyle and required surgical reconstruction using plates and condylar prosthesis (Osteomed 214-0300 right/Left) with reconstruction screw. had CT/CBCT scan data in the region of the mandible (DICOM), Patients age is over 12 years old, where all primary dentition is already disappeared and a maximum of 65 years of age. The patient had post-operative CT/CBCT data in

form of DICOM over 6 weeks yet not more than 12 months post-operative resection surgery, the patient is receiving resection surgery of the jaw for the first time.

Measurement is done by one observer to avoid any misconception and interpretation of 2D slice imaging using digital measurement tools feature available in imaging software (RadiAnt DICOM viewer. Version 2022.1.1. (64-bit): Poland).

Results

We collected 21 patients with ameloblastoma that had mandibular reconstruction and there are only 6 patients who had reconstruction surgery with condylar prostheses on its side.

No Patient	Sex	position of prosthesis	age	Pre-Op scan (mm)			Post-Op scan (mm[		
				Inter condylar	horizontal	vertical	Inter condylar	Horizontal	Vertical
1	Women	Left	65	100.44	8.01	5.02	116.1	9.88	8.79
2	Women	left	59	102.7	6.64	2.28	113.21	8.42	9.69
3	Women	left	23	94.73	9.38	2.9	89.33	6.85	4.43
4	Women	right	22	97.62	8.41	3.75	99.71	9.09	9.81
5	Man	Right	50	97.7	9.02	3.34	98.24	9.98	3.88
6	Man	right	36	98.82	9.06	3.24	97.32	8.12	2.05
7	Women	Left	17	99.45	4.38	6.21	97.14	4.11	4.48
8	Women	Left	23	89.33	8.12	6.55	96.6	10.9	7.02

Table 1. Patient measurement from the preoperative scan and post-operative scan.

no	Sex	position of prosthesis	age	difference (postop-preop)		
				intercondylar	horizontal	vertical
1	Women	Left	65	15.66	1.87	3.77
2	Women	left	59	10.51	1.78	7.41
3	Women	left	23	-5.4	-2.53	1.53
4	Women	right	22	2.09	0.68	6.06
5	Man	Right	50	0.54	0.96	0.54
6	Man	right	36	-1.5	-0.94	-1.19
7	Women	Left	17	-2.31	-0.27	-1.73
8	Women	Left	23	7.27	2.78	0.47

Table 2. Difference of measurement in preoperative – postoperative result.

Based on the measurement result, we found that most of the patients had mandibular resection with condylar disarticulation on the left side, the range for age is between 17-65 years old with the highest preoperative intercondylar measurement at 102.70 mm and lowest at 89.33 mm. For the post-operative result the same patient also had the highest intercondylar distance of 113.21 mm but for lowest intercondylar distance is on patient 3 with 89.33 mm. For horizontal measurement in the preoperative scan, patient 3 has the highest measurement at 9.38 mm meanwhile lowest is found in patient 7 with 4.38 mm. For post-operative scan in horizontal measurement, patient 8 has the highest measurement at 10.90 mm, meanwhile, the lowest is in patient 7 with 4.11 mm. The result for vertical measurement in the preoperative scan showed the highest value in patient 8 at 6.55 mm and the lowest in patient 6 at 2.05 mm. The postoperative result is found in patient 4 with the highest value for vertical measurement at 9.81 mm, and the lowest value in patient 6 at 2.05 mm.

We found that patient diversity results for measurement intercondylar, horizontal and vertical distance in condyle position, we did paired T-Test for statistic analysis. Statistical results for the difference in pre-operative and post-operative scans in intercondylar measurement difference $p>0.05$ (0.227), for horizontal measurement difference $p>0.05$ (0.404) and for vertical measurement, $p>0.05$ (0.116). From the statistical result, we can conclude there is no significant result between measurement for an intercondylar, horizontal and vertical distance of condyle in post-operative compared to preoperative measurement. Clinical evaluation showed all patients had no trismus or limitation for mouth opening, with mouth opening >35mm, no clicking sound during mouth closing/opening, and patients were able to do the lateral movement of the jaw. There are no complications that appear such as wound dehiscence, plate fracture, plate exposure or infection in all patients.

Discussion

In this research group, we found that most of the patients with mandibular resection and condylar disarticulation are mostly women (66.67%) and the rest are men (33.33%). This is linear with a study by Fregnani et al. (2010) involving 113 patients with ameloblastoma, which collected a male group of 48% and a female group of 52%.[12] However, this group age does not represent the epidemiology of the case since the sample group is very small. The age group of samples is range from 17-65 years old, and there are 4 patients in the group aged 20-40 years old, this is linear with the research from Agbaje, et al (2018) that found age group 20-40 years old has the highest prevalence of ameloblastoma.[13,14]

The result showed that the highest difference in measurement is in patients 1 and 2 for intercondylar distance, both are elderly patients (65 and 59 years old). We assume that the patients already had ameloblastoma tumours for a long period since the nature of ameloblastoma is slow growing tumour, possibility that the patient has adapted to the growth of the tumour. Over a long period, this will result in deviation and mandibular asymmetry which resulted in increasing intercondylar distance. Research by Agbaje, et al (2018) that evaluated 1246 patients with ameloblastoma found that the posterior mandible has the highest prevalence for ameloblastoma (31.3%) and mean age of ameloblastoma is found in the age of 20-40 years old (32.1%).[13,15]

There was only a small difference regarding measurement in the horizontal and vertical distance in the condyle, except for patient 1 and 2. This is possible due to the growing size of the tumour which already adapts over time regarding the age of the patient. Condylar prosthesis reconstruction will try to replace the disarticulated condyle similar to proper and adequate condition. Meanwhile, the small difference in horizontal and vertical measurement is due to the shape of the fabricated condyle prosthesis where there is only 2 type of condylar titanium available (Osteomed 214-0300) for left or for right side replacement. The shape of the prosthesis is also made similar to the original shape of an adult condyle, this resulted prosthesis could fit in the glenoid fossa more properly.[7]

Morever, the use of condylar prothesis can decrease range of motion of both condylar heads including the natural contralateral condylar head thus affecting the function of both temporomandibular joint.[16] It also can be a viable option for TMJ reconstruction without donor site morbidity. However, the use of this method is not without significant limitations and complications. Since there is no virtual planning associated eith the placement of condylar prothesis and often times of significant portion of the resected mandible alomg with the condyle, accurate placement of the condylar prothesis will become a complocated endeavor.[17] Therefore, long-term evaluation is required since condyle prosthesis has the risk of displacement due to usage.

Conclusions

Titanium condylar prosthesis could be considered as a temporary condylar prosthesis, its ability to replace the position and function of the disarticulated condyle in ameloblastoma patients showed a satisfactory result. Another advantage is that it could provide a quick replacement without using any autogenous graft from the patient itself. However, long-term evaluation is required since condyle prosthesis has the risk of displacement due to usage. This study only shows the condyle prosthesis evaluation less than 6 months postoperatively.

The limitations of this study also include the retrospective nature of the study design in collecting samples, the relatively small sample size, and the heterogeneity of the group sample. These factors may have contributed to the inconsistency in the reconstruction and measurement of the position of the prosthesis although all samples were reconstructed using the same condylar prosthesis brand, however, surgery is done not by one surgeon which may affect the surgical outcomes. Furthermore, because of the small sample size, appropriate statistical analysis confirming the significance of factors associated with prosthesis retention could not be validated although a statistical test could show there is no significant difference in the result.

Declaration of Interest

The authors report no conflict of interest.

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