10.5005/jp-journals-10012-1032

CLINICAL SCIENCE

Benefits of CBCT in Implant Planning

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ABSTRACT

Implant planning in many cases can be very straightforward, yet in some cases, the remaining anatomy can be deceptive in standard radiographs or clinically. The growing use of cone beam computerized tomography (CBCT) has given new views to the practitioner on what lies below the soft tissue and within the bone. This can be essential in planning, where implants can be placed and what ancillary procedures (i.e. grafting) may be needed to place said implants. A case will be presented demonstrating how CBCT and co-axis implant may allow changes in implant position to avoid extensive grafting that may be necessary with standard fixtures.

Keywords: CBCT, Implant, Co-axis, Barium stent.

CASE PRESENTATION

A 46-year-old Latina female presented with no significant medical history. She disclosed that her maxilla had been edentulated prior to the age of 20 and she had been wearing a series of full maxillary dentures over the intervening 28 years. The patient expressed dissatisfaction with removable prosthesis and requested an implant supported fixed prosthesis as a treatment option.

Examination revealed a very steep angle to the premaxilla and it was difficult to determine clinically, how much bone volume was present in the anterior. A CBCT (Sirona Galileos) was taken to evaluate which bone was present to aid in treatment planning. A DICOM file was exported from the Galileos software and imported into ImplantMax (Saturn imaging) for image analysis and implant planning (Fig. 1). Analysis determined that severe resorption had occurred in the premaxilla but sufficient volume of bone was present in the cuspid area bilaterally and distal for placement of three implants in the posterior right and left to support a full arch fixed prosthesis. Virtual implants were placed in the software at potential positions and the treatment plan was developed (Fig. 2).

As bone volume is critical to implant long-term stability, the authors decided to take a new scan with a barium infused CT stent. This would allow determination of how thick the soft tissue was in areas that implants were planned and also permit planning for implant locations that corresponded with tooth positions, where actual teeth would be positioned prosthetically. The patient's current full maxillary denture was used as a template for the CT stent. Utilizing a lang denture duplicator (Lang Dental, Wheeling, IL, USA), one half of duplicator was filled with mixed alginate. Before the material could set, the denture was inserted, teeth first, into the wet alginate and the material was carried to the edges of flanges. Upon setting, the second batch of alginate was mixed and placed into the tissue side of the denture and the other half of the duplicator was filled with additional alginate and the duplicator was closed. Following setting of the second batch of alginate, the duplicator was opened. The denture is removed carefully from the duplicator. It should be noted that fresh alginate will not adhere to set alginate so that a mold replicating the denture is made with the duplicator. A 40% barium infused acrylic (Jet XR 40%, Lang Dental, Wheeling, IL, USA) was mixed to a runny viscosity and poured into the areas in the alginate corresponding with teeth and allowed to set. Upon setting the resin was removed and trimming was made to remove flash at the cervical of the joined teeth. Teeth were reinserted into the mold and a batch of 20% barium infused acrylic (Jet XR 20%, Lang Dental, Wheeling, IL, USA) was mixed to a runny viscosity and poured into the duplicator and the duplicator was closed and inserted into a pot of hot water to help accelerate the set of the resin. The benefit of using acrylics with two different barium concentrations is that differentiation between the teeth and denture base can be observed in the scan. This is beneficial as determination of soft tissue thickness can be accessed providing additional information for planning purposes. After 60 minutes, the duplicator was opened and the barium infused CT stent was removed. Flash at the flanges was adjusted with an acrylic bur. It should be noted that incorporation of the barium in the acrylic resin makes the resin more brittle, so care should be taken with thin flanges to avoid breakage (Fig. 3).

A second CBCT scan was taken with the patient wearing the barium infused CT stent (Fig. 4). Using the ImplantMax software axial slices were made at the planned implant sites (Fig. 5). The benefit of CBCT is the ability to look at these axial slices, which are taken in buccal-lingual direction

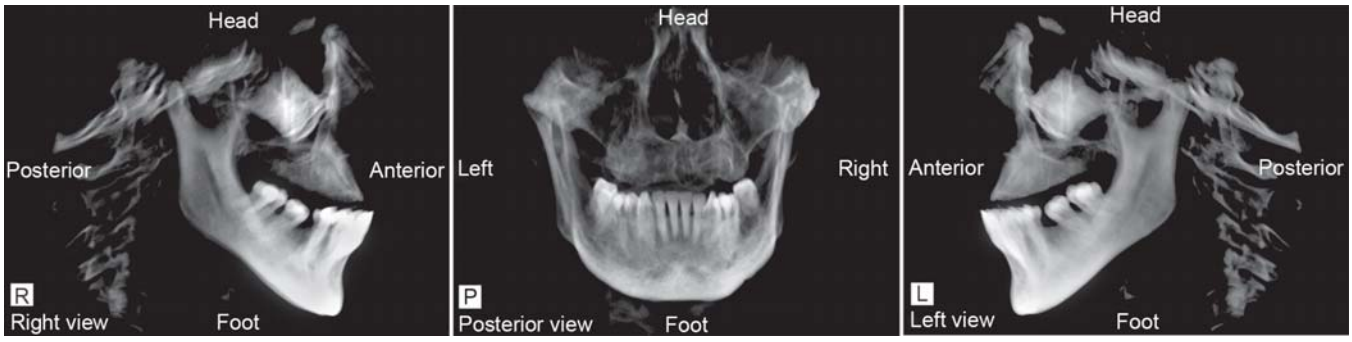


Fig. 1: Initial CBCT scan to determine, which bone was available

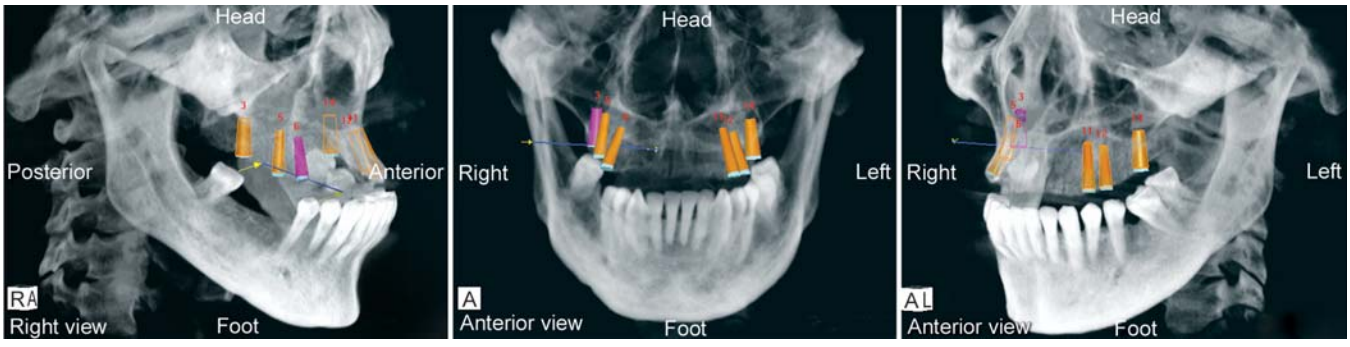


Fig. 2: Virtual planning of implant positions

Fig. 3: Barium infused acrylic CT stent

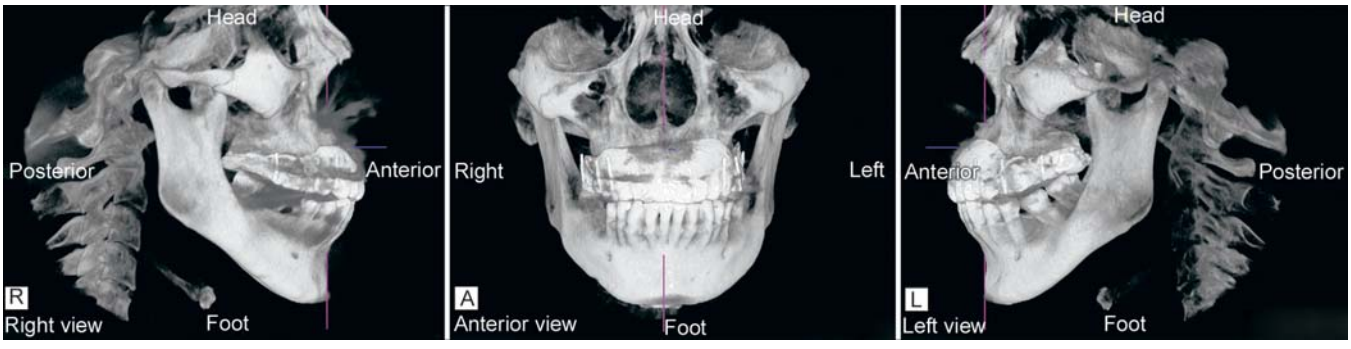


Fig. 4: CBCT scan taken with barium infused acrylic stent in position

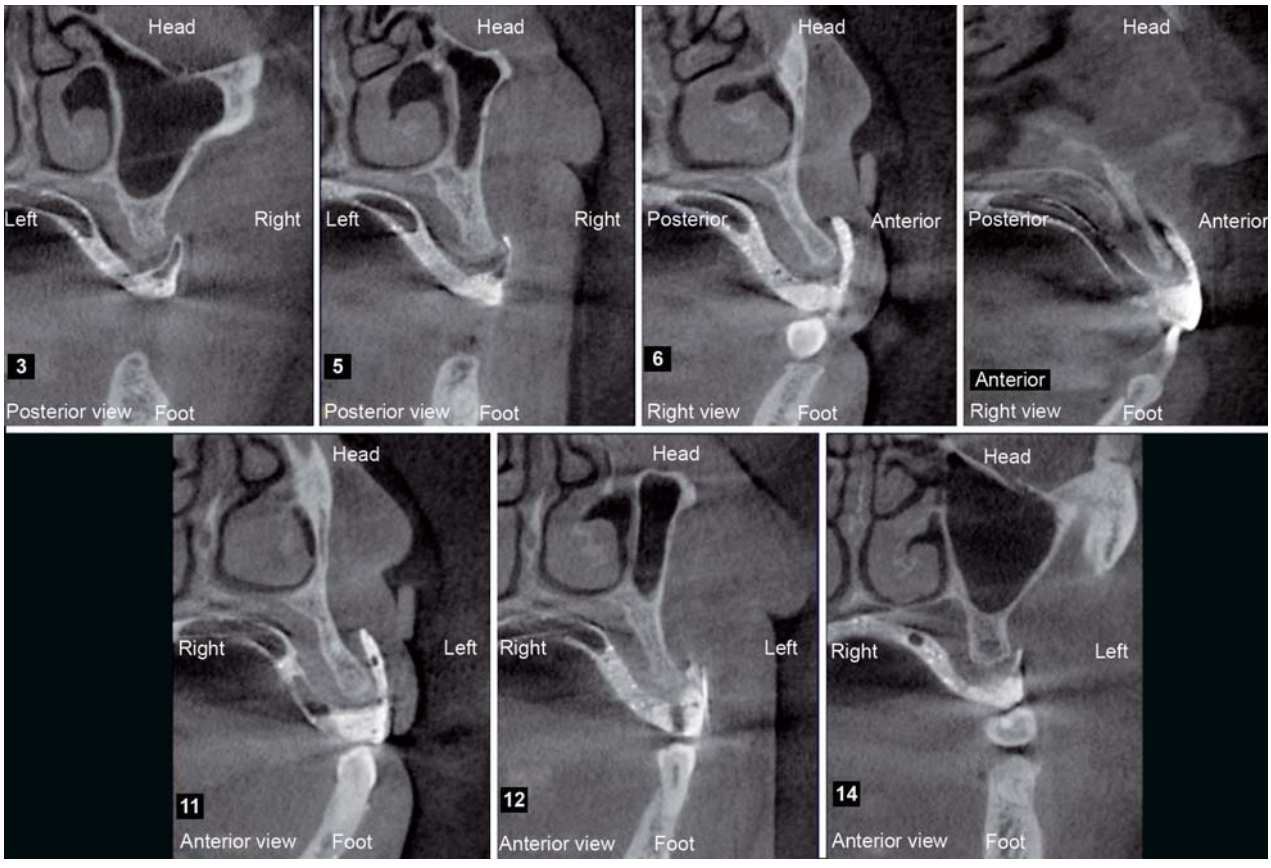


Fig. 5: Axial slices at the planned implant positions

allowing the practitioner a true determination of the volume of bone available. Traditional radiographs do not allow this view and bone volume can be deceptive in using them to plan implant placement. The axial slices presented with adequate width of bone at the planned sites and confirmed the need for augmentation to the height at the molar sites via a bilateral sinus lift procedure. There was sufficient height of bone for initial stability at time of the sinus lift, the augmentation could be done simultaneously in single surgical appointment.

Analysis of the anterior maxilla at midline (Fig. 6) with barium CT stent provides us with much information. We can see that only palatal plate remains and to place implants in this region extensive cortical block grafting would be needed. We can also see that the thick soft tissue gave deception that more volume of bone was present then was truly there. Should a practitioner base treatment on traditional radiographs and a flapless approach be used in this case, there would have been no bone to drill the osteotomy and the pilot drill would have scored the plate and not been able to penetrate the remaining thing cortical plate that remained. Had the practitioner approached this with a flapped approach, they would have determined that extensive grafting was needed. This may be beyond the technical abilities of the practitioner and resulted in closure of the site and referral for said grafting.

Osseous trajectory can create some challenges to implant placement. With this in mind and need to bypass anatomical

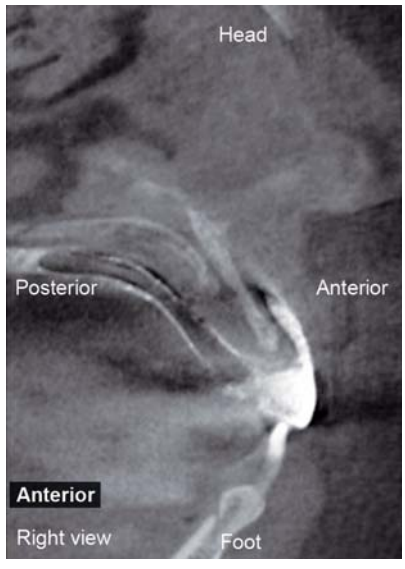


Fig. 6: Axial slice at the midline illustrating the severe bone resorption and what remains of the premaxilla

structures, the co-axis implant (Southern Implants, Irvine, CA, USA) was developed (Fig. 7). This unique implant is available in several diameters and lengths and provides a prosthetic angle correction in the implants plateform of either 12 or 24 degrees.[1] This allows the surgeon to angle the implant to place the fixture in the triangle of bone but not compromise the prosthetics by having the screw access emerge at the facial or require corrections in the abutment to align the fixtures.

Table 1 Implant sizes and positions as used in the case

Site	*Connector*	*Diameter (mm)*	*Length (mm)*	*Type*
3	Ext Hex	5.0	11.5	Tapered
5	Ext Hex	4.0	13.0	Co-axis 12°
6	Ext Hex	4.0	13.0	Co-axis 12°
11	Ext Hex	4.0	15.0	Co-axis 12°
12	Ext Hex	4.0	13.0	Tapered
14	Ext Hex	5.0	11.5	Tapered

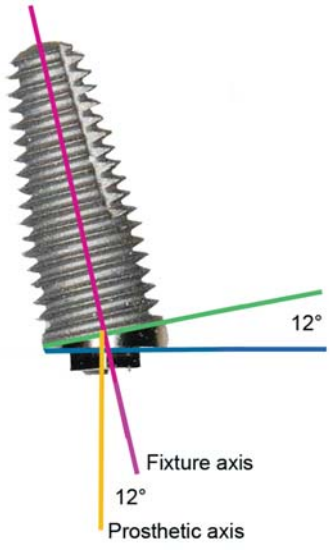


Fig. 7: Co-axis implant demonstrating the prosthetic axis correction within the implants plateform

The patient presented in this case demonstrated a flare buccally of the bone in the cuspid and premolar area. It was decided to place implants (Table 1) so that the screw access hole would lie on occlusal or lingual of each of the fixtures allowing the final restoration to be screw retained full arch hybrid Porcelain to metal prosthetics. The barium CT stent was modified with holes at selected sites to accommodate the pilot drill. As grating was to be included at implant placement a crestal incision was made from the tuberosity on the right to the tuberosity on the left and vertical releasing incisions were made on the buccal. Full thickness flaps were elevated with extension to the nasal fossa in the anterior and the zygoma in the posterior. Lateral windows were created in the buccal osseous plate at the molar sites and elevated in a medial and superior direction. Osteotomies were created in the molar sites to accommodate the selected implant diameter and the elevated sinus area was filled with a mixture of autogenous bone and AlloOss, a mineralized allograft (Ace surgical, Brockton, MA, USA). The molar fixtures were then placed to proper depth. The placement heads were left on the fixtures to help align the Co-axis implants that would be placed anterior to the molar sites. The osteotomies were created for the remaining fixtures paralleling the plateforms to simplify the prosthetic restoration. Placement heads were removed and cover screws placed. As the patient would need to wear a relined full denture during the healing period to minimize unwanted loading of the fixtures but the denture, a 2-stage surgical approach was taken.

To eliminate the deep undercut and allow easier prosthetic restoration of the anterior by the pontics that will replace the lateral and central incisors, it was decided to bulk the buccal aspect of the ridge out by placing graft material in this region. Regeneform (Exatech, Gainesville, FL, USA), a moldable allograft material was placed from the premolar area to the opposing premolar area to bulk the ridge width. A collagen membrane (RCM6 resorbable collagen membrane, Ace surgical) was placed over the graft material and the site was closed by primary closure with PGA sutures in an interrupted fashion. The RCM6 membrane has a 26 to 32 weeks sustained presence before resorption, which will allow the underlying osseous graft to organize before potential in growth of the overlaying soft tissue.

A final CBCT scan was taken to document the implant positions (Fig. 8). Enlargements of the posterior segments

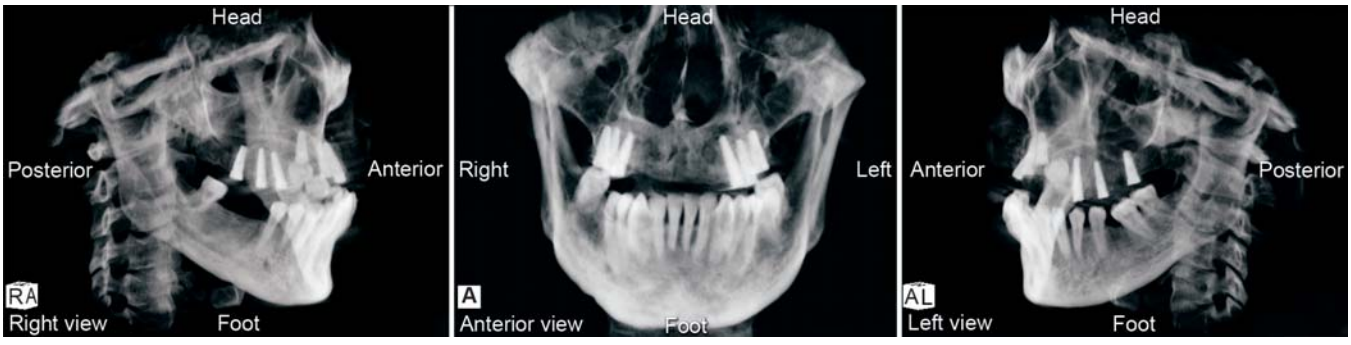


Fig. 8: CBCT scan following implant placement replicating the planned positions

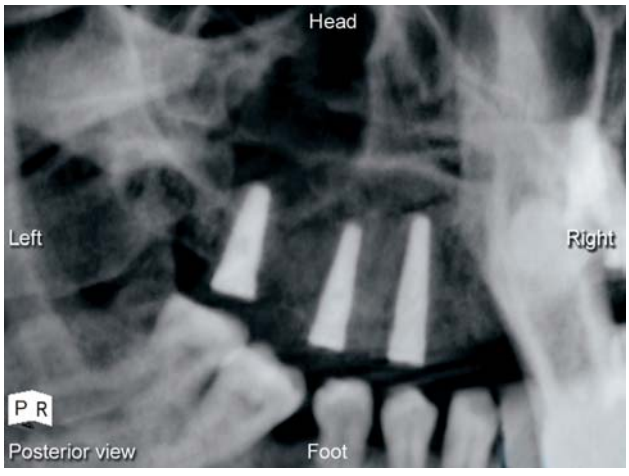


Fig. 9: CBCT scan of the posterior right quadrant showing the implant placement and simultaneous sinus augmentation

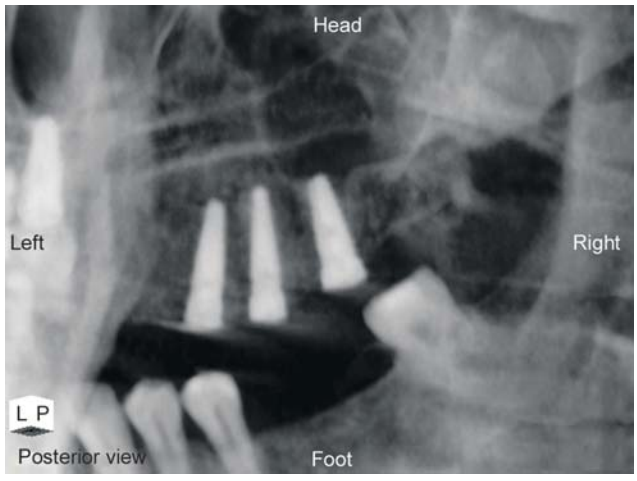
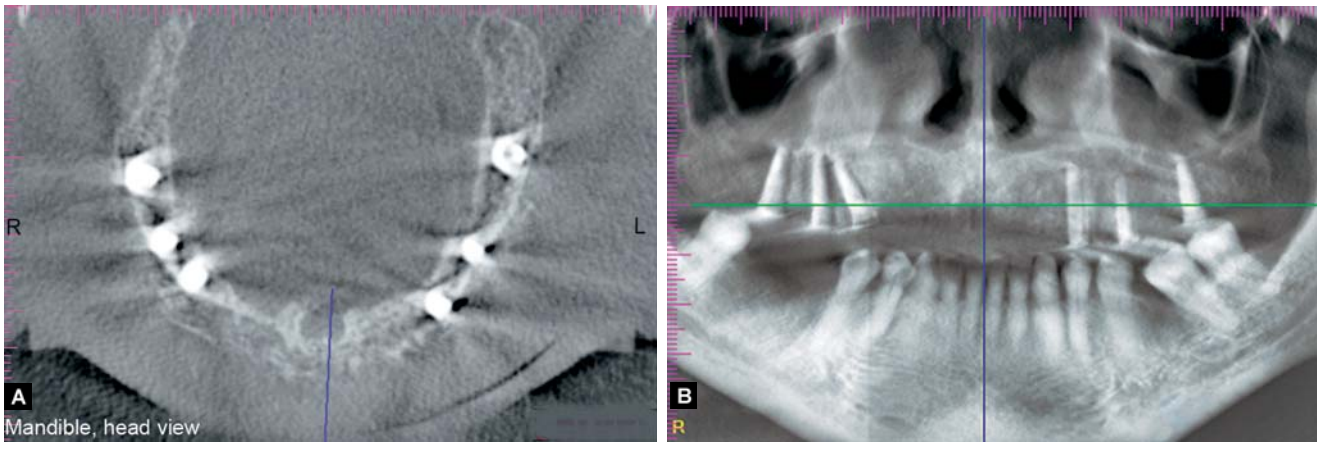


Fig. 10: CBCT scan of the posterior left quadrant showing the implant placement and simultaneous sinus augmentation



Figs 11A and B: CBCT panoramic view and horizontal slice demonstrating implants placed within the osseous walls of the ridge that was present. The augmentation of the deficient anterior facial is also noted

(Figs 9 and 10) allow us to see the implants lie within bone in each dimension. To confirm that each fixture is surrounded by osseous tissue at the cervical, a horizontal slice demonstrates full encapsulation of each fixture (Figs 11A and B). Comparison of figures 2 and 8 to 10 illustrates how accurate the virtual planning positions can be replicated three dimensionally with actual positions after placement.

The denture was modified to accommodate the new buccal anterior dimensions and was then relined with a soft liner (Permasoft, Dentsply Prosthetics, York, PA, USA). A healing period of 6 months will be allowed for integration of the fixtures and incorporation of the grafts.

CONCLUSION

Good preplanning can eliminate issues during surgical placement. This requires information about the bone in all axis (X, Y and Z) as well as how this bone relates to anatomical features that could hamper placement, such as nerves and sinus. Traditional radiographs only provide visualization in the vertical (X-axis) and horizontal (Y-axis) providing only a 2D image. CBCT in providing information in all three axis, allow through software manipulation of the data visualization so that implants can be planned for placement to avoid structures and keep them situated within the available bone.

REFERENCE

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