Case Report

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Immediate dental implantation after indirect sinus elevation using osseodensification concept: a case report

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Introduction and importance: Implantation in the posterior maxilla is more challenging due to the insufficient bone height after maxillary sinus pneumatization and the low bone density. Osseodensification (OD) is considered a novel, less invasive, and more effective indirect sinus floor elevation technique.

Case presentation: A 52-year-old male presented to the oral and maxillofacial surgery department with a main complaint of chewing difficulties in the right posterior area maxilla (teeth numbers: 26 and 27). A cone-beam computed tomography (CBCT) imaging showed that the residual bone height ranged between 1 and 4 mm and the width ranged between 9 and 12 mm in the area of teeth numbers 16 and 17.

Intervention and outcome: The treatment plan was to extract the teeth (numbers: 16 and 17) and conduct internal sinus lifting and bone grafting using the OD burs with immediate implantation.

Clinical discussion: OD is proposed as an alternative procedure to the direct (lateral window) sinus floor elevation procedure. The amount of vertical bone gain obtained by this technique in transcrestal sinus lifting can be the same as external sinus lifting in this case.

Conclusion: OD can be considered a promising technique for direct sinus floor elevation, considering the amount of vertical bone gain obtained by this technique.

Keywords: bone graft materials, implantology, indirect sinus floor elevation, osseodensification

Introduction

Decreased residual bone height (RBH) and bone quality are unfavorable conditions for implantation in the posterior maxilla. The most common reason for insufficient bone height is maxillary sinus pneumatization[1]. Thus, direct or indirect sinus floor elevation is indicated to secure sufficient bone height for placing implants[2]. In this favor, osseodensification (OD) burs (Densah burs) are used to densify alveolar bone and elevate the sinus membrane by rotating in the noncutting counterclockwise (CCW) direction[3]. The modified transcrestal approach using Densah burs is suggested when the RBH is less than 5 mm instead of the lateral approach. This paper presents a case of severe chronic periodontitis in the right posterior maxilla requiring bone augmentation and immediate implantation after the extraction of the first and second molars (RBH ranges between 1 and 4 mm). We prepared this case report in accordance with SCARE 2020[4].

HIGHLIGHTS

- Searching for an alternative to direct sinus floor elevation procedure is very important in specific cases.
- Osseodensification is considered a promising technique in this field.
- The amount of vertical bone gain obtained by this technique in transcrestal sinus lifting can be the same as external sinus lifting.

Importance

The importance of this case can be explained in the following:

1. Indirect sinus floor elevation by Densah burs can be used when the RBH is less than 5 mm.
2. It is proposed as an alternative procedure to the direct (lateral window) sinus floor elevation procedure.
3. In some cases, the amount of vertical bone gain obtained by Densah burs in the indirect sinus lifting can be the same as the lateral approach.

Case presentation

Clinical history and patient information

A 52-year-old male patient presented to the oral and maxillofacial surgery department in the Faculty of Dentistry.

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Sponsorships or competing interests that may be relevant to content are disclosed at the end of this article.

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The main complaint was chewing difficulties in the right posterior area of the maxilla (teeth numbers: 26 and 27). Diagnostic orthopantogram revealed severe chronic periodontitis in both posterior sides of the maxilla with the presence of zirconia crowns on teeth numbers: 16, 17, 26, and 27. A cone-beam computed tomography (CBCT) imaging was performed to assess the treatment options. The patient's main perspective was to get the most safe surgical procedure to restore the losing teeth. Medical history of the patient revealed no genetic problems or drug abuse in the family. No other psychological or genetic problems were detected.

CBCT before the surgery (T0) showed that the RBH ranged between 1 and 4 mm and the width ranged between 9 and 12 mm in the area of teeth numbers 16 and 17 (Figs 1A, B). The treatment plan was determined and discussed with the patient to obtain his informed consent.

The treatment plan included the extraction of teeth numbers: 16 and 17 and conducting internal sinus lifting and bone grafting by using the Densah burs with immediate implantation. The patient had no contraindication for the surgery, and the procedure was scheduled in the implantology clinic at the oral and maxillofacial department.

Surgical procedures

The patient was pre-medicated with a levofloxacin 750 mg tablet 60 min before the surgery, then the mouth was disinfected using a mouth rinse (chlorhexidine 0.12%), the skin around the mouth was antisepticized, and the surgical area was isolated using sterile surgical scrubs. Local (buccal and palatal) infiltration was performed using 4% articaine hydrochloride with epinephrine 1:100 000. Teeth numbers 16 and 17 were extracted (Fig. 1), then a midcrestal incision was performed, and a full-thickness flap was raised along the alveolar ridge.

Drilling was started using the 1.8 mm pilot drill to determine the two implant sites. Then, drilling was changed into reverse (densifying) mode, which was CCW, and the drill speed was 1000 RPM with copious irrigation.

The OD was started with a 3-mm-diameter Densah bur, and a gentle pressure with a pumping motion was applied to reach the sinus floor. When reaching the sinus floor, the bur started a vibrating motion. This is a result of the unique design of the Densah bur, which allows it to compress and densify the bone in all directions, preserving and autografting the bone until the sinus floor was penetrated.

The densification was continued using the Densah burs with the following sequence: 3.5 mm – 4.0 mm – 4.5 mm – 5.0 mm – 5.5 mm. Furthermore, the sinus membrane was visible and intact in all densifying stages, and all the drills did not exceed the sinus floor by more than 3 mm. Then, a mixture of allograft and beta-tricalcium phosphate (1:1(was grafted into the sinus through both osteotomy sites without using any collagen membrane.

The last OD bur (5.5 mm diameter) was reused in the densifying mode (CCW) at low speed (200 RPM) without irrigation to propel the graft into the sinus in both sites. The 5.5 mm bur also did not exceed the sinus floor by more than 3 mm to keep the sinus membrane intact during graft propelling. The graft mixture propelling was done in both implant sites, respectively, and it was repeated six times in each implant site.

Each increment of the graft mixture elevated the sinus membrane up to 2 mm.

The distribution of the graft mixture was checked by an intraoral periapical radiograph using a Vatech sensor (Fig. 2).

The implants (6 mm diameter × 8 mm length Bicon subcrestal) were inserted into the osteotomy sites (Fig. 3).

A periosteal releasing incision was done to secure a tension-free closure for the flap, then horizontal mattress and interrupted suturing was done with nylon reverse cutting needle sutures (4/0). The prosthetic was delivered 6 months postoperatively (Figs 4–6), and a periapical radiograph was done immediately after loading. Six months later, a second periapical radiograph was done (Fig. 7). The surgical procedure was performed by the oral and maxillofacial resident with the supervision of a professor in the same department.

Postoperatively, the patient was instructed to keep good oral hygiene and was prescribed levofloxacin 750 mg q.d. for 5 days post-surgery and potassium diclofenac 50 mg t.i.d. for 5 days post-surgery. Sinus precautions were recommended (e.g. no nose blowing, use of nasal decongestants). Sutures were removed 10 days post-surgery.

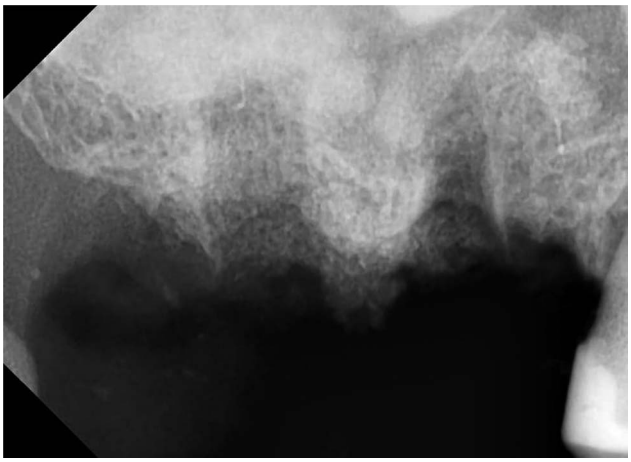

Figure 1. After teeth numbers 16 and 17 were extracted.

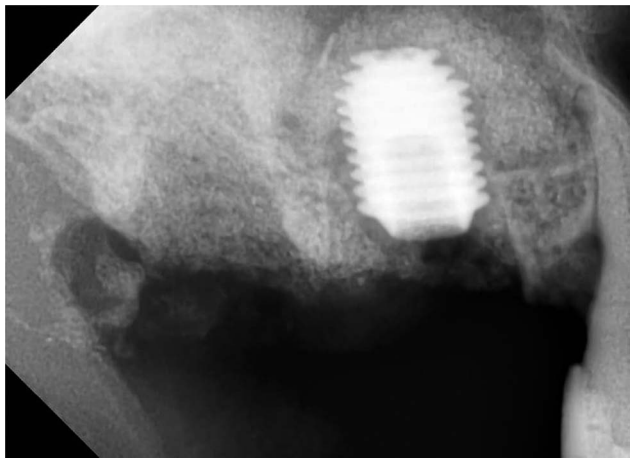

Figure 2 . Bone graft propelling and first implant insertion.

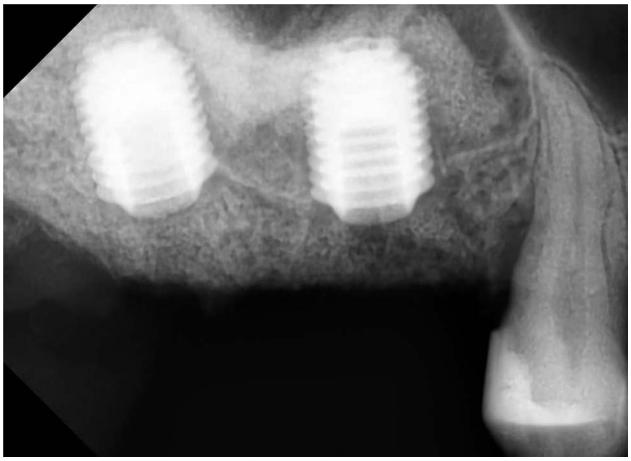

Figure 3. Periapical radiograph immediately after implant insertion.

Radiographic evaluation

The patient was instructed to undergo CBCT imaging preoperatively (T0), immediately postoperative (T1), and 6 months after surgery (T2).

The fusing between every two radiographs was done using the OnDemand3D program to maximize the accuracy of the radiological comparison.

The measurement was done after the center of each implant was determined at the fused image in the sagittal and coronal planes.

Measurement methodology

The following distances were measured on the sagittal and coronal views (Figs 8–10):

- M_0: is the mesial RBH before the extraction, which will interface with the implant mesially.
- CS_0: is the RBH before the extraction, which will correspond to the implant's center on the sagittal view.
- D_0: is the distal RBH before the extraction, which will interface with the implant distally.
- B_0: is the buccal RBH before the extraction, which will interface with the implant buccally.

Figure 4. Gingival healing.

Figure 5. Implants' abutments.

- CC_0: is the RBH before the extraction, which will correspond to the implant's center on the coronal view.
- P_0: is the buccal RBH before the extraction, which will interface with the implant palatally.
- M_1: is the parallel distance to the implant long axis, which measures from the mesial implant platform to the highest bone margin at the T1 CBCT.
- CS_1: is the parallel distance to the implant long axis, which measures from the center of the implant platform to the highest bone margin at the T1 CBCT on the sagittal view.
- D_1: is the parallel distance to the implant long axis, which measures from the distal implant platform to the highest bone margin at the T1 CBCT.
- B_1: is the parallel distance to the implant long axis, which measures from the buccal implant platform to the highest bone margin at the T1 CBCT.
- CC_1: is the parallel distance to the implant long axis, which measures from the center of the implant platform to the highest bone margin at the T1 CBCT on the coronal view.

Figure 6. Final prosthetic.

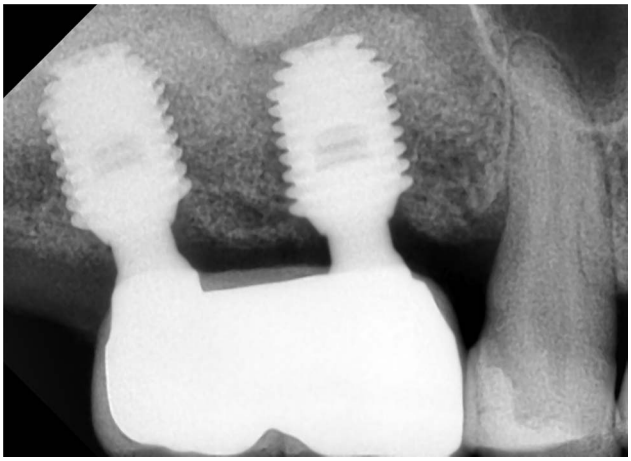

Figure 7. Six months follow-up.

- P_1: is the parallel distance to the implant long axis, which measures from the palatal implant platform to the highest bone margin at the T1 CBCT.
- M_2: is the parallel distance to the implant long axis, which measures from the mesial implant platform to the highest bone margin at the T2 CBCT.
- CS_2: is the parallel distance to the implant long axis, which measures from the center of the implant platform to the highest bone margin at the T2 CBCT on the sagittal view.
- D_2: is the parallel distance to the implant long axis, which measures from the distal implant platform to the highest bone margin at the T2 CBCT.
- B_2: is the parallel distance to the implant long axis, which measures from the buccal implant platform to the highest bone margin at the T2 CBCT.
- CC_2: is the parallel distance to the implant long axis, which measures from the center of the implant platform to the highest bone margin at the T2 CBCT on the coronal view.
- P_2: is the parallel distance to the implant long axis, which measures from the palatal implant platform to the highest bone margin at the T2 CBCT.

The mean residual bone height: $RBH_0 = (M_0 + CS_0 + D_0 + B_0 + CC_0 + P_0)/6$.

The mean bone height at (T1): $BH_1 = (M_1 + CS_1 + D_1 + B_1 + CC_1 + P_1)/6$.

The mean bone height at (T2): $BH_2 = (M_2 + CS_2 + D_2 + B_2 + CC_2 + P_2)/6$.

The amount of sinus floor elevation (SFE): $SFE = BH_1 - RBH_0$.

The amount of endo sinus bone gain(BG): $BG = BH_2 - RBH_0$.

The amount of endo sinus bone reduction (*BR*): $BR = BH_2 - RBH_0$.

Results

The first implant site:

$$SFE = 6.53 \pm 0.942$$

$$BG = 7.03 \pm 0.878$$

$$BR = 0.17 \pm 0.589$$

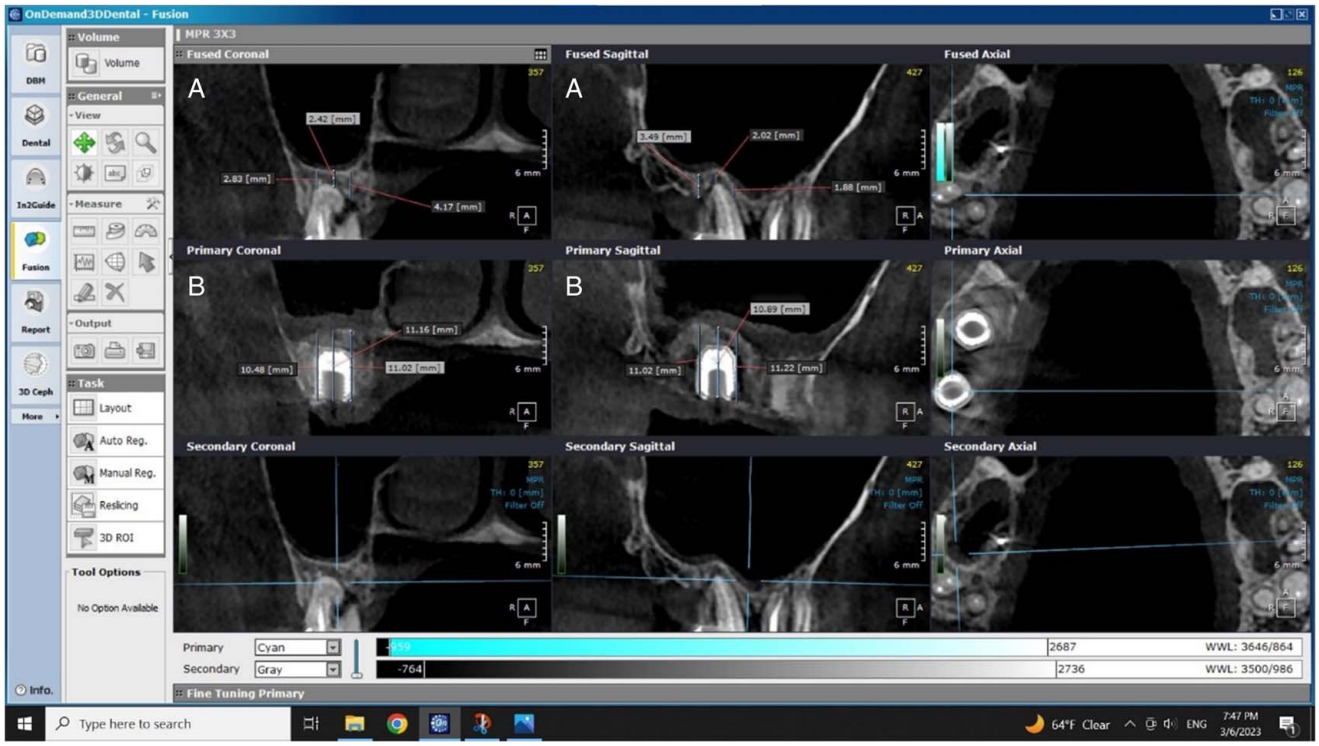

Figure 8. Merged images using OnDemand3D program: (A) preoperative and (B) immediately after surgery.

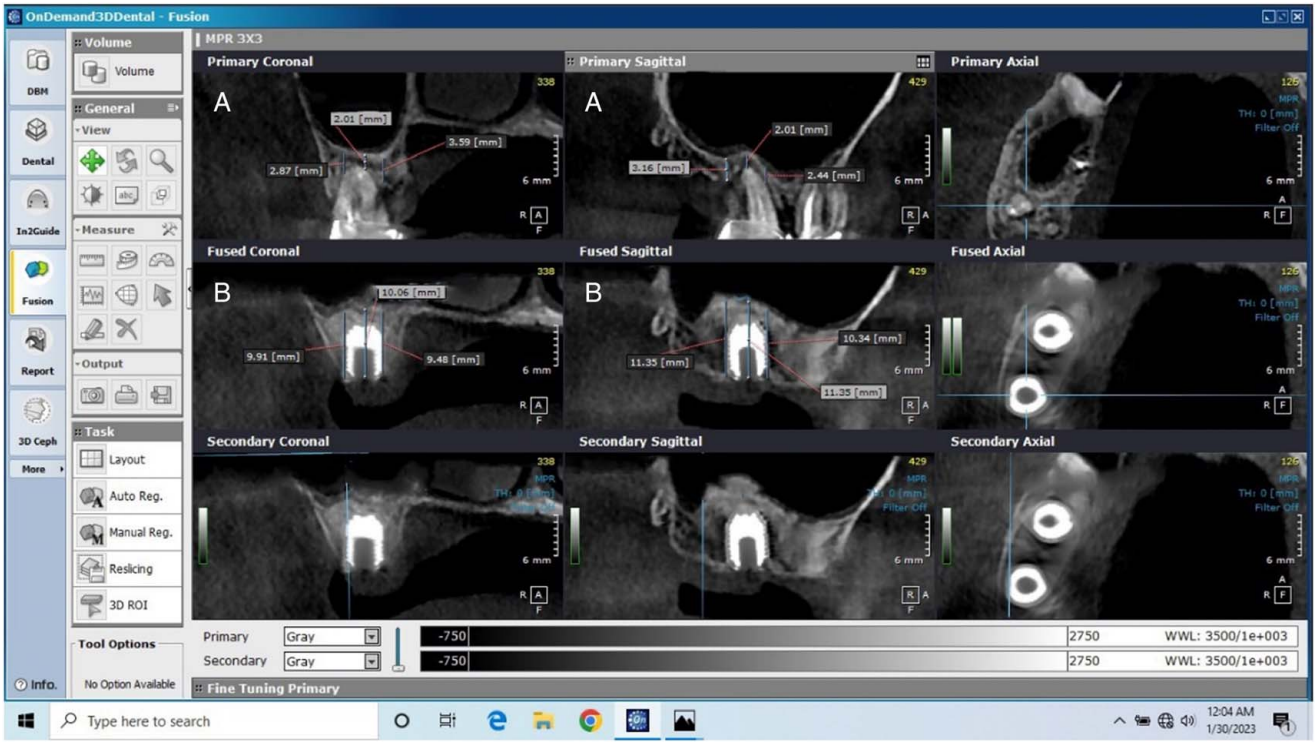

Figure 9. Merged images using OnDemand3D program: (A) preoperative and (B) 6 months postoperative.

Figure 10. Merged images using OnDemand3D program: (A) immediately after surgery and (B) 6 months postoperative.

The second implant site:

$$SFE = 8.16 \pm 0.959.$$

$$BG = 7.75 \pm 1.275.$$

$$BR = 0.38 \pm 0.518.$$

Clinical discussion

In the posterior maxilla, when the RBH is less than 5 mm, external sinus lifting was always the best method to secure sufficient bone height for implantation[5,6]. However, the implantation was always delayed because of the low density of the bone and the lack of primary stability, and the Bone-to-Implant Contact of the implants in this area[7].

Some techniques used the transcrestal approach to increase the bone height in such cases (osteotomes, balloon, piezosurgery, etc.)[8,9]. These techniques were more favorable because they were simpler and caused fewer complications than the lateral approach technique[10].

The use of the crestal approach techniques increased the bone height without improving the quality of the bone, so the implantation was also delayed.

OD is a new technique developed by Huwais 2013[3]. OD can be done by using specially designed burs (Densah burs). The using of the Densah burs in the CCW mode allows densifying, condensing, preservation, and autografting the bone in all directions, which enhances the Bone-to-Implant Contact[11], and it also reduces the risk of complications such as sinus membrane perforation and bleeding compared to other techniques, so the implantation could be done in the same lifting and grafting procedure through the transcrestal approach[12].

Densah burs does not work with cortical bone as cortical bone lacks plasticity and the minimum width when the RBH is less than 4 mm should be at least 7 mm[13].

The usage of Densah burs can elevate the sinus membrane more than 8 mm, and also improve the bone quality, so the implants were inserted in the same elevating and grafting stage without using a collagen membrane[14]. On the other hand, the other transcrestal lifting techniques elevated the sinus membrane between 4 and 12 mm also without using collagen membrane but the implantation was delayed because of the lack of primary stability.

Wang *et al.*[15] presented sinus floor elevation through a trancrestal window approach and delayed implantation for 9 months after the sinus lift procedure; the RBH was 1–2 mm and the bone gain was about 13 mm before the implant placement surgery.

Salgar[14] presented three cases of transcrestal sinus floor elevation using the OD burs when the RBH was 1.5 mm or less, and the vertical increase after the lifting procedure was between 10.3 and 13.6 mm without simultaneous implantation.

Using Densah burs in such cases should be well planned, as well as the skill and advanced training of the surgeon, and the amount of bone graft material should be carefully controlled to avoid overpacking the sinus and causing complications[14].

In this case, on the radiographic follow-up, the bone gain was more stable in comparison with the other techniques, a probable reason is the tenting effect caused by the implants, which protected the bone graft from sinus membrane pneumatization.

Despite this case's limitation, the Densah burs can be an effective technique in sinus floor elevations compared to the lateral approach without delaying the implantation stage[16].

Conclusion

Finally, using the OD concept in transcrestal sinus lifting for the severed absorbed posterior maxilla increases the bone height and the bone-to-implant contact percentage, so the implantation could be done in the same lifting procedure, which reduces the treatment period. It also produces fewer complications than the lateral approach. So OD is a safe and effective technique in transcrestal sinus lifting.

Ethical approval

We obtained the ethical approval from the scientific committee in the Faculty of Dentistry, Damascus University, to accomplish this case (No: 092022135).

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

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This work was done with direct support from the University.

Author contribution

M.M.: performing the surgery and writing the manuscript; M.A. A.: assisting in the surgery and monitoring the radiologic images; A.Alnour: critical review of the manuscript; E.A.: assisting in writing the manuscript; A.Alnajjar: assisting in the surgery; Z.K. B.: supervising the surgical and clinical steps.

Conflicts of interest disclosure

The authors declare that they have no conflicts of interest.

Research registration unique identifying number (UIN)

1. Name of the registry: not applicable.
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3. Hyperlink to your specific registration (must be publicly accessible and will be checked): not applicable.

Guarantor

Dr Amirah Alnour.

Data availability statement

The data that support the findings of this study are openly available.

Provenance and peer review

This work is not commissioned, externally peer-reviewed.

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