Clinical application of Minne Ties® for intraoperative maxillomandibular fixation during temporomandibular joint replacement surgery

Aplicação clínica do Minne Ties® para fixação maxilomandibular intraoperatória durante substituição total da articulação temporomandibular

Aplicación clínica de Minne Ties® para fijación maxilomandibular intraoperatoria durante reemplazo total de la articulación temporomandibular

ABSTRACT

Objective: To describe and evaluate the use of the Minne Ties® Agile MMF device as an alternative method of maxillomandibular fixation (MMF) in temporomandibular joint (TMJ) reconstruction surgery. Maxillomandibular fixation (MMF) is essential in oral and maxillofacial surgery, particularly in trauma, orthognathic surgery, and TMJ reconstruction. Traditional wire-based techniques, although effective, are associated with prolonged operative time, increased risk of needle-stick injuries, and gingival trauma. The Minne Ties® Agile MMF is an innovative suture-based device that allows rapid, safe, and minimally invasive intraoperative fixation, using a monofilament loop passed through the interdental spaces, without the use of wires or screws. **Case report:** We report a case of bilateral total TMJ replacement in which Minne Ties® was used for intraoperative MMF, detailing the preoperative evaluation, surgical workflow, and postoperative outcomes. The device provided secure occlusal stabilization, reduced surgical complexity, and minimized tissue trauma. **Conclusion:** This case demonstrates the efficacy and safety of Minne Ties® as an alternative to conventional MMF methods, highlighting its usefulness in complex TMJ reconstruction procedures. **Keywords**: Jaw Fixation Techniques, Temporomandibular Joint, Joint Prosthesis.

RESUMO

Objetivo: Descrever e avaliar o uso do dispositivo Minne Ties® Agile MMF como método alternativo de fixação maxilomandibular (FMM) em cirurgia de reconstrução da articulação temporomandibular (ATM). A fixação maxilomandibular (FMM) é essencial na cirurgia bucomaxilofacial, principalmente em trauma, cirurgias ortognáticas e reconstrução da ATM. Técnicas tradicionais com fios, embora eficazes, apresentam tempo operatório prolongado, risco aumentado de ferimentos por agulha e trauma gengival. O Minne Ties® Agile MMF é um dispositivo inovador baseado em sutura que permite fixação intraoperatória rápida, segura e minimamente invasiva, utilizando um laço de monofilamento através dos espaços interdentais, sem o uso de fios ou parafusos. **Relato de caso:** Relatamos um caso de substituição total bilateral da ATM em que o Minne Ties® foi utilizado para FMM intraoperatória, detalhando avaliação pré-operatória, fluxo cirúrgico e resultados pós-operatórios. O dispositivo proporcionou estabilização oclusal segura, reduziu a complexidade cirúrgica e minimizou trauma tecidual. **Conclusão:** Este caso evidencia a eficácia e segurança do Minne Ties® como alternativa aos métodos convencionais de FMM, destacando sua utilidade em proce-

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dimentos complexos de reconstrução da ATM. **Palavras-chave:** Técnicas de Fixação da Arcada Osseodentária, Articulação Temporomandibular, Prótese da Articulação.

RESUMEN

Objetivo: Describir y evaluar el uso del dispositivo Minne Ties® Agile MMF como método alternativo de fijación maxilomandibular (FMM) en cirugía de reconstrucción de la articulación temporomandibular (ATM). La fijación maxilomandibular (FMM) es esencial en la cirugía bucomaxilofacial, principalmente en el trauma, la cirugía ortognática y la reconstrucción de la ATM. Las técnicas tradicionales con alambres, aunque eficaces, presentan un tiempo operatorio prolongado, mayor riesgo de lesiones por aguja y trauma gingival. El Minne Ties® Agile MMF es un dispositivo innovador basado en sutura que permite una fijación intraoperatoria rápida, segura y mínimamente invasiva, utilizando un lazo de monofilamento a través de los espacios interdentales, sin el uso de alambres ni tornillos. **Reporte de caso:** Se reporta un caso de reemplazo total bilateral de la ATM en el que se utilizó Minne Ties® para la FMM intraoperatoria, detallando la evaluación preoperatoria, el flujo quirúrgico y los resultados postoperatorios. El dispositivo proporcionó una estabilización oclusal segura, redujo la complejidad quirúrgica y minimizó el trauma tisular. **Conclusión:** Este caso evidencia la eficacia y seguridad del Minne Ties® como alternativa a los métodos convencionales de FMM, destacando su utilidad en procedimientos complejos de reconstrucción de la ATM. **Palabras clave**: Técnicas de Fijación de Maxilares, Articulación Temporomandibular, Prótesis de la Articulación.

INTRODUCTION

Maxillomandibular fixation (MMF) has historically served as the foundation for achieving occlusal stability in maxillofacial surgical procedures, including trauma management, orthognathic surgery, and temporomandibular joint (TMJ) reconstruction.[1,2,3] Classical techniques, such as Erich arch bars and intermaxillary wiring, have demonstrated reliable occlusal stabilization over decades. However, these methods are associated with inherent limitations, including prolonged operative time, significant risk of sharps injuries to the surgical team, and trauma to the gingival and periodontal tissues[2,4,5]. These drawbacks have catalyzed the development of alternative MMF strategies designed to improve efficiency, reduce morbidity, and enhance intraoperative workflow.

Screw-based MMF systems emerged as a less invasive alternative to conventional arch bars. These devices allow fixation via alveolar screws without engaging the dentition directly, reducing gingival trauma and simplifying application.[6,7] However, screw-based systems are not without complications, including potential dental root injury, neurovascular compromise, and hardware loosening, particularly in patients with compromised bone quality. Hybrid techniques, which combine screw and wire elements, aim to balance stability with lower morbidity but still require invasive hardware placement and may not be suitable for all fracture patterns.[6]

Recently, suture-based devices such as Minne Ties® Agile MMF have gained attention. The device consists of a monofilament loop threaded through interdental embrasures using a blunt introducer, allowing secure temporary fixation without wires or screws.[1,8] By eliminating sharp exposure and minimizing soft tissue trauma, Minne Ties® can reduce operative complexity while maintaining reliable occlusal stabilization. Clinical studies have reported that the device can be applied in under 15 minutes, providing secure intraoperative fixation in patients undergoing orthognathic or TMJ procedures.[8] The system received FDA 510(k) clearance in 2017 for use in adults requiring temporary intraoperative MMF.[9] There are relative limitations or contraindications like compromised occlusion with missing dentition, loose teeth, many open interproximal contacts, comminuted fractures in the setting of trauma, periodontal disease, and a need for postoperative elastic therapy.[2,3]

These different techniques have their unique advantages and weaknesses. Selection should depend on surgical goals, including specific needs of each surgery, the need to maintain occlusion postoperatively or not, application and removal time, safety, and patient comfort and less trauma for soft tissue and teeth involved.[10]

The present report describes the clinical application of Minne Ties® in a patient undergoing bilateral TMJ total joint replacement, highlighting preoperative evaluation, surgical workflow, and postoperative outcomes. This study emphasizes the advantages of suture-based MMF in terms of efficiency, safety, and reduced soft tissue trauma.

CASE REPORT

An established patient, previously seen for right TMJ osteoarthritis (Wilkes Stage 4), confirmed by MRI in June last year, presented to the Carolinas Center for Oral & Facial Surgery (Raleigh, NC), for a new clinic evaluation. This time she reported a new onset of left-sided TMJ pain, rated 6-7/10,

with joint noises and difficulty consuming certain solid foods. She related a progressively worsening situation, although she had pursued conservative management with physical therapy, Botox injections, corticosteroids, NSAIDs, muscle relaxants, massage therapy, dry needling, and other modalities. While these non-surgical measures offered some relief for years, she now reports a significant worsening of symptoms. Her pain has become constant and is only partially managed with regular use of analgesics and anti-inflammatories. She also reports persistent pain while chewing and progressive reduction in maximal incisal opening (MIO), which was measured at 33 mm, and had mandibular excursion movements limited by pain (Fig. 1). At bilateral palpation, it was possible to feel TMJ crepitus, with audible popping and clicking. She was referred to get updated images and was asked to return with these results. The computer tomography showed slight flattening of the bilateral mandibular condyles with a tiny marginal osteophyte on the right and subcortical sclerosis on the left. Her magnetic resonance imaging showed flattening of the mandibular condyles with moderate narrowing of the joint space and marginal osteophytosis (Fig. 1).

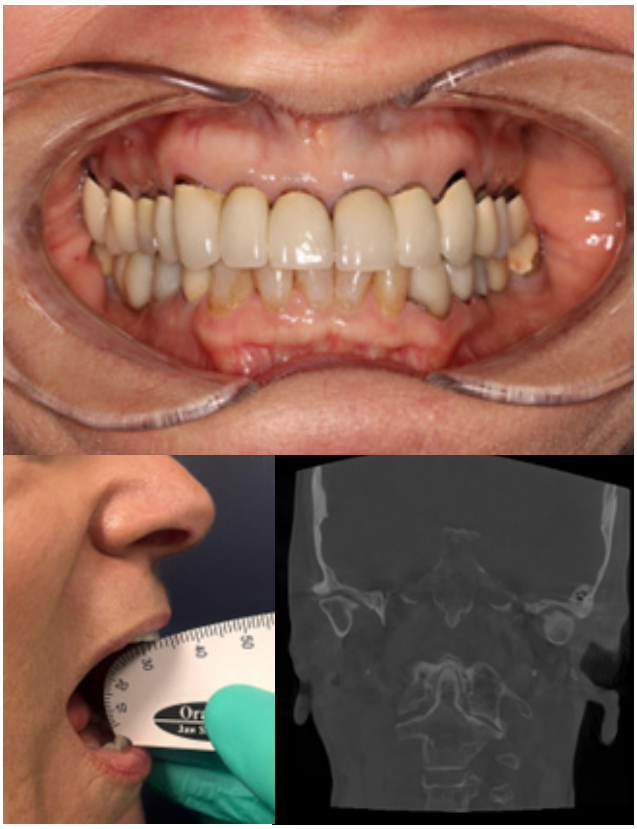

Figure 1 - A: Stable Class I malocclusion; B: Maximum incisal opening without pain; C: Cortical irregularity and flattening of the mandibular condyles with a marginal osteophyte on the right and subcortical sclerosis on the left.

The articular discs were displaced anteriorly in the closed-mouth position, and there was no recapture during mouth opening on both sides. The right articular disc was small and deformed, and her right articular tubercle was eroded, but there was no joint effusion or abnormal enhancement within the right joint space or its periarticular soft tissues, and the bone marrow signal was normal. However, there was mixed bone marrow edema and sclerosis in the condylar head and in her articular tubercle on her left side with abnormal enhancement of periarticular soft tissues and a small amount of joint effusion. These recent images associated with her clinic symptoms reveal degenerative changes consistent with bilateral TMJ osteoarthritis, compatible with Wilkes stage V.

The patient was counseled again regarding two options: continued non-surgical management, which she has already pursued extensively without long-term success, or surgical reconstruction with bilateral total joint replacement and autologous abdominal fat grafting. After a detailed discussion, the patient opted for surgical intervention, understanding that the goal is not complete pain elimination, but rather reduction to a manageable level and restoration of functional mastication. Risks, including facial nerve injury, infection, heterotopic bone formation, and parotid gland injury, were discussed in detail. The patient voiced understanding and desire to proceed.

Subsequently, she had intraoral scanning and photographic documentation obtained, and that information, along with the DICOM files, was sent to Biomet for the total TMJ prostheses planning. For intraoperative maxillomandibular fixation (MMF), the possibilities would be hybrid arch bars, MMF screws, or Minne Ties®. Due to the patient's good periodontal health and adequate interproximal spaces, Minne Ties® would be a less invasive and comfortable treatment option. After completion of virtual surgical planning, the patient was scheduled for elective surgery at UNC Rex in Raleigh, NC.

When the patient presented preoperatively at the hospital, informed consent was verified with her, and any questions were invited and answered after reviewing the risks and benefits of the procedure. The patient was then transferred to the operating room and onto the operating room table without issues. All appropriate monitors were attached and verified to be working correctly. The patient then underwent nasal endotracheal intubation without complication. End-tidal CO2 as well as bilateral breath sounds were verified. The tube was then secured by the surgical team. Subsequently, both right preauricular and submandibular incisions were marked, then lidocaine with epinephrine was injected. Next, Minne Ties® were placed on the posterior aspect of the arches, and MMF was achieved (Fig. 2).

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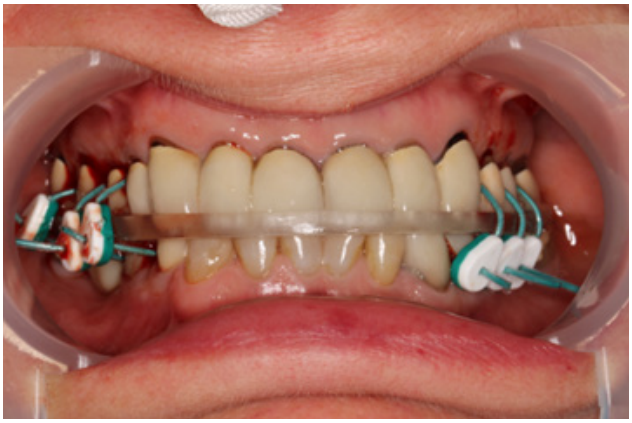


Figure 2 - Intraoperative use of Minne Ties® placed interdentally posteriorly with the splint positioned before the TMJ prosthesis fixation.

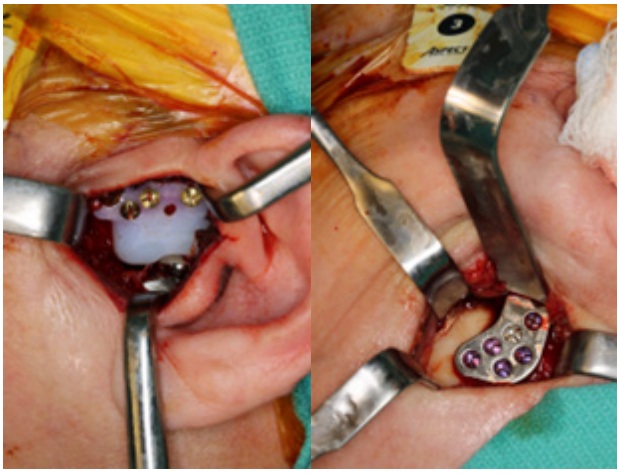
The patient was then prepped and draped in standard sterile fashion. Attention was turned to the abdomen. A semilunar incision along the inferior aspect of the umbilicus was made using an 11-blade through skin and subcutaneous tissue. Metzenbaum scissors were used to dissect through the fascia until fat was identified. The fat was grasped using hemostats, and a segment of fat was freed using scissors. This fat graft was divided into two pieces and set on the back table. Copious irrigation of the wound was done, and then it was closed in layers.

The next step was the right submandibular incision. A 15-blade was used to incise through the skin, and blunt dissection was performed down to the level of the platysma. An incision was made into the platysma, and a nerve stimulator was used to protect the marginal mandibular nerve. The marginal mandibular nerve was not identified. Ligasure was utilized to dissect deep to the platysma. Once the pterygomasseteric sling was identified, the area was tested with the nerve stimulator, and a sharp incision was performed down to the mandible with electrocautery. Subperiosteal dissection was carried out along the lateral ramus to the condyle. A Sonopet® was utilized to make the condylotomy according to the virtual planning. Hemostasis was obtained, and the wound was packed and covered with a sterile dressing.

Attention was then drawn to the right preauricular incision. A 15-blade was used to incise through the skin. Dissection was then carried down to the zygomatic arch with electrocautery. Subperiosteal dissection was carried anteriorly along the zygomatic arch, exposing the articular eminence. Inferior blunt dissection was performed using a 9 Molt periosteal elevator to fully expose the lateral capsule of the TMJ. Next, the superior joint space was entered using electrocautery. A Seldin elevator was placed into the joint space. The disc and condyle were retracted inferiorly, then a 15-blade was used to finish the incision of the capsule along the zygomatic arch. Bovie electrocautery was then used to create a vertical incision through the disc, exposing the degenerative condyle, which was removed. The joint space and remaining disc were cleaned with a 9 Molt periosteal elevator, and the remaining disc was removed with electrocautery.

The right Biomet® fossa component was then soaked in betadine, then placed into the wound and adapted to the bone with good stability. The bone was sounded in each of the four holes to ensure there was excellent adaptation and bone according to the surgical plan. Superior pressure was used to maintain position while the holes were drilled under copious irrigation, and the fossa component was then stabilized with Biomet® screws according to the pre-surgical planning. The wound was copiously irrigated with normal saline, and next a moist ray-tec was packed into the wound.

Attention was then returned to the right submandibular incision. The prepared right Biomet® mandibular component was soaked in betadine. The condylar component was then applied along the lateral surface of the mandibular ramus from the submandibular incision. The condyle component was visualized from the preauricular incision and found to be seated posteromedially in the fossa component. From the retromandibular incision, the mandibular component was found to be adapted and fitted appropriately to the lateral ramus. It was secured with Biomet® screws according to the pre-operative plan. It was again confirmed that the condylar head portion of the prosthesis was seated firmly, medially, and slightly posteriorly in the prosthetic fossa component. Copious irrigation of the wound with saline was done, then, attention was returned to the right preauricular approach, and hemostasis was ensured using electrocautery. The harvested fat was then placed in the wound along the prosthesis, and the approaches were closed in layers. The same surgical technique was done on the left side to provide the treatment according to the virtual planning (Fig. 3).



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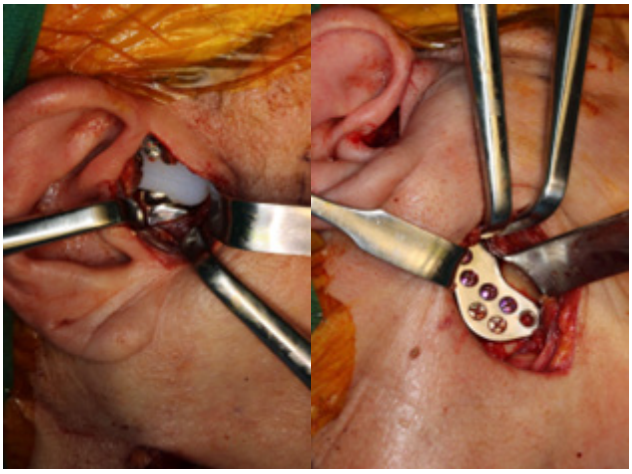

Figure 3 - Bilateral mandibular and condyle components fixed as previously planned.

As the procedure had been completed, the Minnie Ties® were removed, the occlusion was checked and drapes were removed. Subsequently, the patient was cleaned and turned back to the Anesthesia Care Team to be awakened and transferred to the post-anesthesia care unit for the postoperative recovery.

The patient returned 10 days after the bilateral total joint prosthesis replacement for her first postoperative evaluation. She reported doing well overall and had facial edema consistent with the procedure. There was a mild left mandibular ecchymosis, no facial nerve weakness, sutures were removed, and she was educated about avoiding the sun and using a scar gel formula. Her occlusion was stable and reproducible, and she had 25mm of MIO. Then she was educated about physiotherapy and about using Therabite that was adjusted to 35mm. The CBCT showed well-positioned implants and no abnormalities (Fig. 4). She was discontinued on oxycodone and oriented to use paracetamol just if necessary.

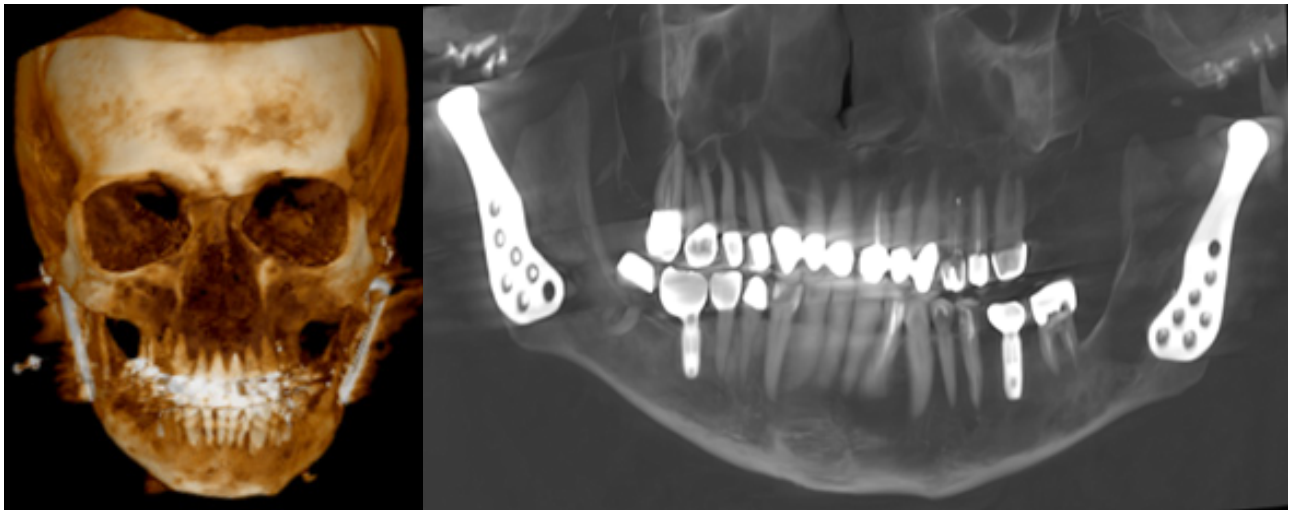

Figure 4 - Images showing both prostheses in good position.

For her one-month postoperative return, she reported significant improvement compared to preoperative pain levels, transitioning back to a normal diet, she reported sleeping better, and denied any episodes of numbness, nerve weakness, swelling, or signs of infection. A prescription of cyclobenzaprine 5mg nightly was provided to optimize muscle relaxation and facilitate the Therabite use and maximize postoperative MIO.

DISCUSSÃO

This case demonstrates the successful application of Minne Ties® for intraoperative MMF in bilateral TMJ total joint replacement. Intraoperative occlusal stability is critical for accurate alignment of prosthetic components and restoration of function.[1,2] Traditional wire-based methods, while effective, are time-consuming and expose the surgical team to sharps injuries, whereas screw-based systems, despite efficiency gains, carry risks of root damage and hardware loosening.[2,4,6,7]

Minne Ties® provide a suture-based, minimally invasive alternative. The device's blunt introducer allows rapid placement without gingival injury or sharps exposure.[8] Conventional MMF techniques, including Erich arch bars and intermaxillary wiring, though reliable, are time-consuming and expose clinicians to percutaneous injury risks.[1,2,3] Johnson et al. (2025) reported secure fixation in under 15 minutes, with minimal tissue trauma and no adverse periodontal outcomes. However, they provided a decision algorithm with a framework for considering criterias and other inherent strengths and weaknesses of each technique to optimize patient outcomes while minimizing costs, time, and risks to both the patient and the surgical team. Jenzer et al. (2022), in a multi-institutional series of TMJ replacement,

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confirmed the device's safety and effectiveness in temporary intraoperative MMF, noting improved workflow efficiency compared with traditional methods. Similar findings have been echoed in case reports and clinical series documenting reduced operative time and improved workflow efficiency compared to wire-based systems.

In the present case, Minne Ties facilitated rapid and secure occlusal stabilization without interfering with surgical access, consistent with previously reported benefits. Their noninvasive design and blunt introducer minimize soft tissue injury—an advantage particularly relevant in lengthy reconstructive procedures. Furthermore, the absence of screw placement eliminates postoperative root sensitivity and risk to neurovascular structures, which are recognized complications of alternative systems.

While Minne Ties are contraindicated for long-term postoperative immobilization or in cases of extensive dental spacing or comminuted fractures, [9,10] they remain particularly well-suited for intraoperative stabilization in orthognathic or TMJ replacement surgery.[3] Their ease of application, low morbidity, and favorable safety profile support their inclusion in modern MMF armamentaria. The use of Minne Ties® for this case of bilateral total temporomandibular joint replacement was a safe, fast, and effective alternative to IMF screws or hybrid arch bar devices in achieving MMF. Minne Ties® have demonstrated advantages over traditional MMF. The advantages particularly observed in this case include: 1) reduced operative time for MMF, 2) elimination of sharps injury risk, 3) minimal soft tissue trauma, and 4) maintenance of stable occlusion throughout surgery.

CONCLUSION

Minne Ties® for intraoperative MMF during bilateral TMJ replacement proved to be a safe, efficient, and minimally invasive alternative to traditional fixation methods. This case reinforces the value of individualized surgical planning and highlights the potential of suture-based MMF devices in complex maxillofacial procedures. As surgical techniques continue to evolve, Minne Ties® may play an increasingly prominent role in enhancing patient outcomes and streamlining operative protocols.

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