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Resorbable Implants for Mandibular Fracture Fixation: A Systematic Review and Meta-Analysis

Yehuda Chocron, MD*
Alain J. Azzi, MD, MSc*
Sabrina Cugno, MD, FRCSC*

Background: Mandibular fractures in adults commonly require rigid fixation to ensure proper occlusion while minimizing infection risks. Numerous centers have assessed the efficacy of resorbable materials as a potential alternative to metallic plates. The purpose of the current systematic review and meta-analysis is to shed light on overall outcomes for resorbable implants and to compare these results to those for metallic counterparts.

Methods: A systematic review of clinical studies reporting outcomes for resorbable plates for mandible fractures was carried out. The reported outcomes were hardware failure/exposure, infection, wound dehiscence, reoperation, malocclusion, and nonunion. The results were pooled descriptively and stratified according to fracture and implant type. A subset meta-analysis of prospective studies comparing metallic and resorbable implants was also carried out.

Results: Eighteen studies were included for a total of 455 patients managed with resorbable implants (mean follow-up, 8.95 months) with an overall complication rate of 19.8 % (n = 90/455). Infection (n = 31/455, 6.8%) and wound dehiscence (n = 28/455, 6.2%) were the most common complications. Nonunion occurred in 1.1% (n = 5/455) of patients. Seven studies were included in a meta-analysis, and the rates of adverse events in the resorbable and metallic groups were 18.0% (n = 32/178) and 18.3% (n = 33/180), respectively, with no statistically significant difference between both cohorts (95% CI 0.58, 1.82, $P = 0.93$).

Conclusions: This study suggests that there are no statistical differences in outcomes for patients with mandible fractures managed with resorbable or metallic implants. In the absence of meta-analyses or large randomized controlled trials, the current study provides surgeons with an evidence-based reference to guide decision-making. *(Plast Reconstr Surg Glob Open 2019;7:e2384; doi: 10.1097/GOX.0000000000002384; Published online 30 August 2019.)*

INTRODUCTION

The mandible represents one of the most common sites of involvement for adult craniofacial trauma.[1,2] Mandibular fractures most commonly occur in young adults following blunt trauma such as motor vehicle accidents, assault, and falls.[3] Given that this population engages in at risk behaviors, there is an increased susceptibility to postoperative complications, making prompt diagnosis and management a necessity.[4] In the majority of cases, rigid fixation is required to ensure maintenance of proper occlusion and fracture stabilization while minimizing the risk of infection.[1,4] In select cases, namely nondisplaced fractures without evidence of malocclusion or fracture mobility, conservative management with a soft diet may be sufficient.[1,5] Historically, open reduction and internal fixation (ORIF) for traumatic mandibular fractures has been achieved through the use of metallic plates, namely titanium. Metallic implants carry the benefit of providing the necessary tensile strength to withstand forces of mastication while limiting fracture mobility. However, metallic plates can be palpable, which necessitates secondary surgery for removal and have been associated with interference of radiologic examinations, possible hardware migration, thermal sensitivity, osteolysis, corrosion, and periimplant soft tissue reactions.[6–10] Concerns regarding the use of metallic fixation devices led to the advent of resorbable materials, which were initially developed to avoid secondary surgery for implant removal.[11] Early monomeric forms

*From the *Division of Plastic and Reconstructive Surgery, McGill University, Montreal, Quebec, Canada; and †McGill University, Montreal, Quebec, Canada*

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of biodegradable implants, namely poly-L-lactide, were associated with delayed degradation (>5 years), which led to reports of foreign-body reactions, local fistulas, osteolytic lesions, and peri-implant fluctuant swelling.[7,12,13] However, with the development of advanced copolymers, self-reinforcing materials, and increased control over degradation rates, recent studies have shown promising results.[14,15] In light of this recent evidence, and the increasing use of biodegradable implants for mandibular fracture fixation, it is of great value to shed light on overall complication rates and long-term functional outcomes. Given that the literature is devoid of any recent comprehensive reviews comparing outcomes of resorbable and metallic implants for fixation of mandibular fractures, we sought to synthesize the available data in an effort to offer an evidence-based view to guide clinical management.

MATERIALS AND METHODS

In accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, a systematic review and meta-analysis of studies indexed to Pubmed, Web of Science, and Cochrane Collaboration Library was carried out.[16] Primary clinical studies evaluating outcomes for traumatic mandibular fractures in adults managed with resorbable implants were included. Studies reporting only on the use of metallic fixation devices, those assessing pathologic mandibular fractures, and studies evaluating pediatric patients were excluded. Prospective studies comparing outcomes between resorbable and metallic devices were included in a meta-analysis. Our search was limited to English and lower-powered studies including case reports and case series (N < 10 fractures) were excluded. Our search strategy consisted of varying combinations of the following terms: [("mandible fracture") AND ("resorbable" OR "absorbable" OR "biodegradable" OR "bioabsorbable") AND ("plate" OR "fixation" OR "open reduction")]. Our search strategy is highlighted in Figure 1. Initial screening was carried out by 2 independent referees on the basis of abstract and title review. Studies deemed eligible were then assessed in full

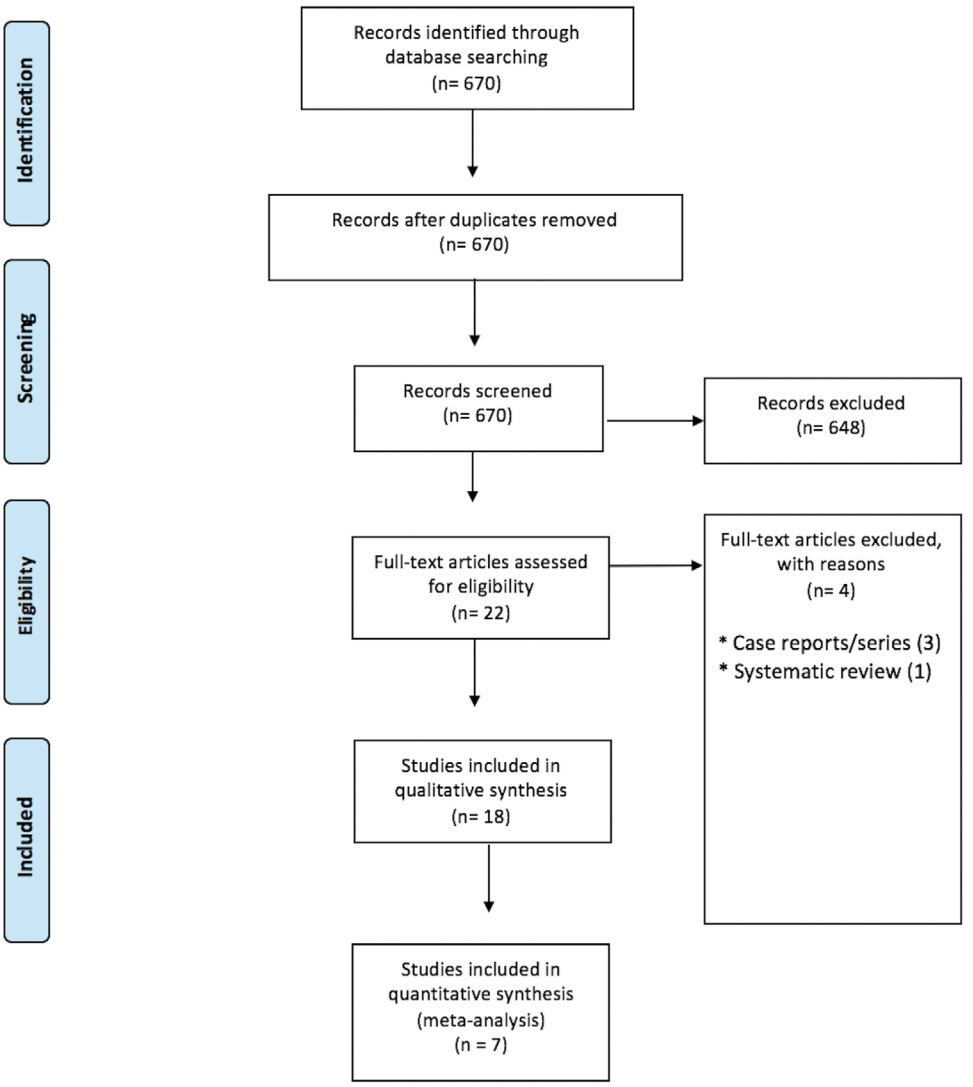

Fig. 1. Search strategy highlighted through the PRISMA diagram

Table 1. Included Studies (N = 18)

Study	Date	N (Patients)	Age (Mean or Range, Years)	Follow-up (Mean or Range, Months)	Material Used (Width in mm)	Study Type (Level of Evidence)
Kim et al.[6]‡‡	2018	13	33.7	16.9	Osteotrans¶ (2.0)	Retrospective cohort (III)
Leno et al.[14]‡‡	2017	21	26.2	12	Bonamates§ (1.5)	Prospective cohort (III)
Bayat et al.[15]	2010	19	27.4	6	INION* (2.5)	Prospective cohort (III)
Ylikontiola et al.[17]	2004	10	32.1	3–6	Biosorb† (n/a)	Prospective cohort (III)
Suzuki et al.[18]	2004	14	17.4–28.8	36	Fixsorb‡ (n/a)	Retrospective cohort (III)
Laughlin et al.[19]	2007	35	29	2	INION* (2.5)	Prospective cohort (III)
Yang et al.[20]	2015	10	28.2	6–12	Biosorb† (2.0)	Case series (IV)
Leonhardt et al.[21]‡‡	2008	30	24	6	INION* (2.0/2.5)	Prospective cohort (III)
Bhatt et al.[22]‡‡	2010	19	26.6	2	INION* (2.5)	RCT (II)
Lee et al.[23]‡‡	2010	48	28.4	12	Biosorb† (n/a)	Prospective cohort (III)
Lim et al.[24]‡‡	2014	13	24.2	3	INION*/Biosorb† (n/a)	Prospective cohort (III)
Ahmed et al.[25]‡‡	2013	34	31.4	3	Bonamates§ (n/a)	RCT (II)
Rha et al.[26]	2015	75	33	6.3	Biosorb†	Retrospective cohort (III)
Son et al.[27]	2017	11	35.3	18.8	Osteotrans¶ (2.0)	Case series (IV)
Ferreti et al.[28]	2008	29	30	1–48	Lactosorb‖	Prospective cohort (III)
Kim et al.[29]	2002	46	27.4	5.85	PLDLA†† (2.0/2.4)	Prospective cohort (III)
Landes et al.[30]	2006	9	28.1	28.3	Polymax**	Prospective cohort (III)
Yerit et al.[31]	2002	19	27.2	11.2	Biosorb†	Prospective cohort (III)

* INION (Inion, Tampere, Finland) or INION (Striker, Germany)
† BiosorbFX (Bionx Ltd, Tampere, Finland)
‡ Fixsorb-MX (Takiron Co Ltd, Osaka, Japan)
§ Bonamates (Bio-Resorbable Osteofixation System, Germany)
¶ OSTEOTRANS MX (Takiron Co., Ltd, Osaka, Japan)
‖ Lactosorb (Walter Lorenz, Jacksonville, Fla.)
**; Polymax (Synthes, Oberdorf, Switzerland)
†† Generic name not provided
‡‡ Studies with a control group (titanium plates)

text by 2 reviewers. Disagreements between referees were resolved by means of consensus. Data extraction was carried out by 2 reviewers in regard to outcomes determined a priori. Baseline study information including patient demographics, length of follow-up, and age at surgery were recorded. The adverse outcomes recorded included hardware failure and exposure, wound dehiscence, and postoperative infections. Long-term outcomes included the presence of fracture malunion or nonunion, occlusal issues, and the need for secondary surgery. The results were stratified according to fracture and implant type.

Subset Meta-Analysis

Randomized controlled trials and prospective cohort studies comparing resorbable and metallic plates were included in a meta-analysis in which outcomes were compared. The variables included were overall complication rates, postoperative infection, wound dehiscence, hardware failure, and malocclusion. Statistical analysis was carried out on Review Manager [(RevMan) computer program. Version 5.3. Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration, 2014]. A fixed-effects model was employed due to the low heterogeneity between included studies. Heterogeneity was tested by means of the χ^2 test and I^2 statistic. $P < 0.05$ was our cutoff for statistical significance. The principle summary measures were reported as odds ratios with the corresponding 95% CI and are presented in forest plots.

RESULTS

Eighteen studies met the inclusion criteria and were included in the final review.[6,14,15,17–31] There were no additional unique studies identified from Web of Science or Cochrane Collaboration Library. The included studies (n = 18) yielded a total of 455 patients with 613 traumatic mandibular fractures treated with resorbable plates. The mean age at the time of surgery was 29.07 years with an average follow-up period of 8.95 months. Eight unique resorbable materials were identified with BiosorbFX (Bionx Ltd, Tampere, Finland) (38.5%) and INION [(Inion, Tampere, Finland) or INION (Striker, Germany)] (21.4%) being most commonly employed. Study characteristics are highlighted in Table 1. The overall pooled complication rate was 19.8% (n = 90/455 patients) with postoperative infection (n = 31, 6.8%) and wound dehiscence (n = 28, 6.2%) being the most commonly encountered adverse events. The rate of postoperative malocclusion was 2.4% (n = 11), and the rate of fracture nonunion was 1.1% (n = 5). Twenty-six patients (5.7%) encountered adverse postoperative events requiring secondary surgery for implant removal (n = 19, 4.2%) or replacement (n = 7, 1.5%). Baseline patient demographics and the breakdown of specific outcomes and complications are highlighted in Table 2.

Outcome Stratification by Fracture Pattern

Thirteen studies reported their outcomes according to the specific fracture pattern and were included in a subset analysis, which accounted for a total of 450 fractures.[6,15,17,18,20,23,24,26–31] Three hundred and ten patients had isolated mandible fractures (1 location), and 72 patients had multiple mandible fractures (≥2 locations) accounting for 140 fractures requiring fixation with a resorbable plate. Condylar fractures (n = 84) were the most common isolated occurrence with 70 subcondylar and 14 condylar

Table 2. Patient Demographics and Complications

No. patients (n)	455
Age (mean*, years)	29.07
Follow-up time (mean†, months)	8.95
Total number of fractures‡ (n)	613
Isolated fractures N (%)	315 (51.4)
Multiple fractures§ N (%)	298 (48.6)
Material used¶	
Biosorb†† N (%)	236 (38.5)
INION‡‡ N (%)	131 (21.4)
PLDLA§§ (70:30) N (%)	66 (10.8)
Bonamates¶¶ N (%)	57 (9.3)
Lactosorb‖‖ N (%)	40 (6.5)
Osteotrans*** N (%)	24 (3.9)
Polymax††† N (%)	19 (3.1)
Fixsorb‡‡‡ N (%)	14 (2.3)
Not specified‖ N (%)	26 (4.2)
Overall complications** N (%)	90 (19.8)
Infection N (%)	31 (6.8)
Wound dehiscence N (%)	28 (6.2)
Malocclusion N (%)	11 (2.4)
Hardware exposure N (%)	10 (2.2)
Hardware failure N (%)	5 (1.1)
Nonunion N (%)	5 (1.1)
Reoperation** N (%)	26 (5.7)

*Based on 442 patients with available mean age
† Based on 407 patients with available mean follow-up time
‡ Fractures operated with resorbable plates
§ Defined as ≥ 2 mandible fracture locations
¶ N referring to number of plates
‖ Either INION or BiosorbFX
** N referring to number of patients
†† BiosorbFX (Bionx Ltd, Tampere, Finland)
‡‡ INION (Inion, Tampere, Finland) or INION (Striker, Germany)
§§ Commercial name not specified
¶¶ Bonamates (Bio-Resorbable Osteofixation System, Germany)
‖‖ Lactosorb (Walter Lorenz, Jacksonville, Fla.)
*** OSTEOTRANS MX (Takiron Co., Ltd, Osaka, Japan)
††† Polymax (Synthes, Oberdorf, Switzerland)
‡‡‡ Fixsorb-MX (Takiron Co Ltd, Osaka, Japan)

process fractures. Combined symphyseal and angle fractures were the most common identified pattern (n = 36). Isolated body, symphyseal fracture, and angle fracture had overall complication rates of 24.1% (n = 7/29), 21.0% (n = 13/62), and 14.1% (n = 11/78), respectively, representing the fractures with the highest rates of adverse events. Combined symphyseal and angle fractures had an overall complication rate of 16.7% (n = 6/36), representing the combined pattern with the highest rate of adverse events. The complete stratification of complications according to fracture type can be found in Table 3.

Outcome Stratification According to Implant Type

Seventeen studies reported their outcomes according to the resorbable material used and were included in a subset analysis.[6,14,15,17–23,25–31] BiosorbFX (Bionx Ltd, Tampere, Finland) (n = 236/613 fractures; 38.5%) and INION [(Inion, Tampere, Finland) or INION (Striker, Germany)] (n = 131/613 fractures; 21.4%) were the most commonly used resorbable materials. Lactosorb (Walter Lorenz, Jacksonville, Fla.) and INION [(Inion, Tampere, Finland) or INION (Striker, Germany)] had overall complication rates of 32.5% (n = 13/40 fractures) and 28.2% (n = 37/131 fractures), respectively, representing the resorbable implants with the highest rates of adverse events. The complete outcome stratification according to implant type can be found in Table 4.

Meta-Analysis

Seven studies had control (metallic plates) groups with or without randomization and were included in our meta-analysis.[6,14,21–25] The overall heterogeneity for our

Table 3. Complications According to Fracture Type (N = 13 Included Studies)

	Infection	Wound Dehiscence	Hardware Failure	Hardware Exposure	Malocclusion	Nonunion
Isolated fractures* (n = 310)						
Condyle (n = 84)	1	—	—	—	1	—
Subcondylar (n = 70)	1	—	—	—	—	—
Condylar process (n = 14)	—	—	—	—	1	—
Angle (n = 78)	8	1	—	—	1	1
Symphysis (n = 62)	7	3	—	—	1	2
Parasymphysis (n = 57)	6	—	—	1	—	—
Body (n = 29)	3	3	—	—	—	1
Multiple fractures* (n = 72)						
Symphysis + angle (n = 36)	2	2	2	—	—	—
Body + angle (n = 12)	—	—	—	—	—	—
Symphysis + condyle† (n = 10)	—	—	—	—	—	—
Parasymphysis + angle (n = 3)	—	—	—	—	—	—
Body + condyle‡ (n = 3)	—	—	—	—	—	—
Symphysis + ramus (n = 1)	—	—	—	—	—	—
Body + ramus (n = 1)	—	—	—	—	—	—
Bil.body (n=1)	—	—	—	—	—	—
Bil.parasymphysis + bil. condyle (n = 1)	—	—	—	—	—	—
Symphysis + bil. condyle (n = 1)	—	—	—	—	—	—
Bil. symphysis + angle (n = 1)	—	—	—	—	—	—
Bil. angle + symphysis (n = 1)	—	—	—	—	—	—
Bil. angle (n = 1)	—	—	—	—	—	—

* n referring to number of patients
† 4/10 condylar fractures were plated due to severe displacement
‡ Fracture not requiring fixation with a plate

Table 4. Complications According to Material Used (N = 17)

	Infection	Wound Dehiscence	Hardware Failure	Hardware Exposure	Malocclusion	Nonunion
Material used*						
Biosorb† (n = 236)	14	4	—	1	—	3
INION‡ (n = 131)	5	16	1	5	9	1
PLDLA§ (70:30) (n = 66)	4	—	—	—	1	—
Bonamates¶ (n = 57)	1	2	2	—	1	—
Lactosorb‖ (n = 40)	5	4	—	4	—	—
Osteotrans** (n = 24)	1	—	—	—	—	—
Polymax†† (n = 19)	—	—	—	—	—	1
Fixsorb‡‡ (n = 14)	—	—	—	—	—	—

* n referring to number of plates
† BiosorbFX (Bionx Ltd, Tampere, Finland)
‡ INION (Inion, Tampere, Finland) or INION (Striker, Germany)
§ Commercial name not specified
¶ Bonamates (Bio-Resorbable Osteofixation System, Germany)
‖ Lactosorb (Walter Lorenz, Jacksonville, Fla.)
** OSTEOTRANS MX (Takiron Co., Ltd, Osaka, Japan)
†† Polymax (Synthes, Oberdorf, Switzerland)
‡‡ Fixsorb-MX (Takiron Co Ltd, Osaka, Japan)

subset analysis was sufficiently low to allow for a fixed-effects model to be employed ($I^2 = 0\%$, $\chi^2 = 4.56$, $P = 0.6$). These studies yielded a total of 178 patients in the resorbable groups and 180 patients in the metallic groups. The overall complication rates for patients treated with resorbable and metallic implants were 18.0% (n = 32/178) and 18.3% (n = 33/180), respectively. There was no statistically significant difference in overall pooled complication rates between patients treated with resorbable and metallic plates (95% CI 0.58, 1.82, $P = 0.93$). Other variables included in the meta-analysis were the rates of postoperative infection, wound dehiscence, hardware failure, and malocclusion. Among these variables, there were no statistically significant differences between the metallic and resorbable groups. The forest plots according to the specific outcomes are highlighted in Figures 2–6.

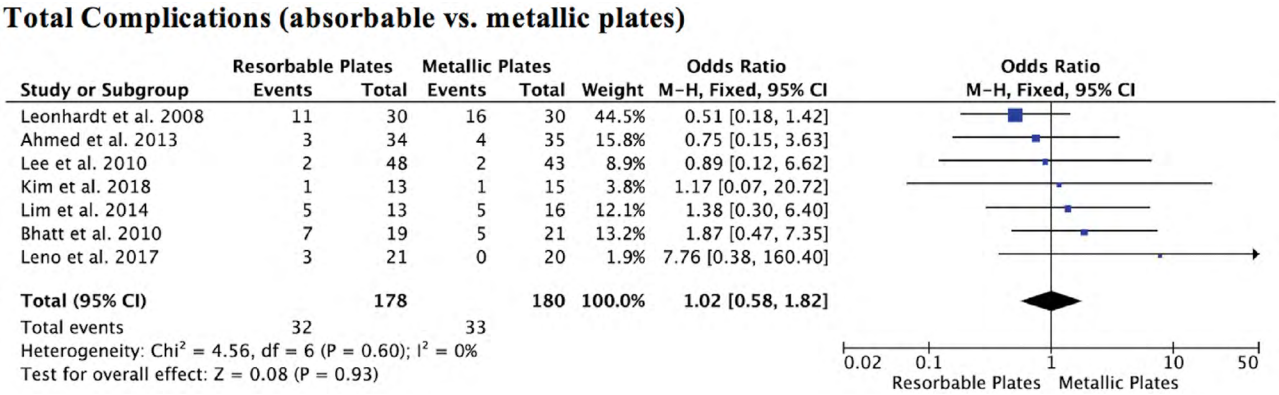

Fig. 2. Forest plot comparing overall complication rates between the metallic and resorbable groups

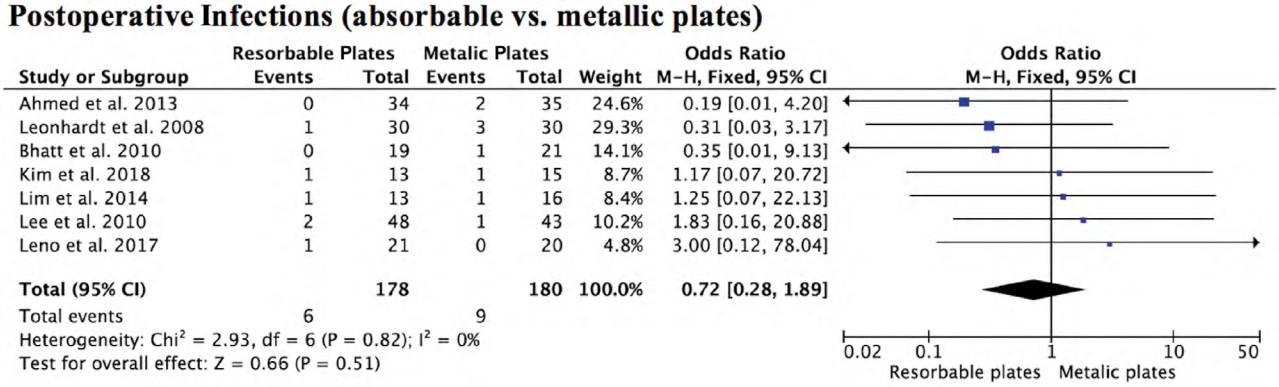

Fig. 3. Forest plot comparing the rate of postoperative infections between the metallic and resorbable groups

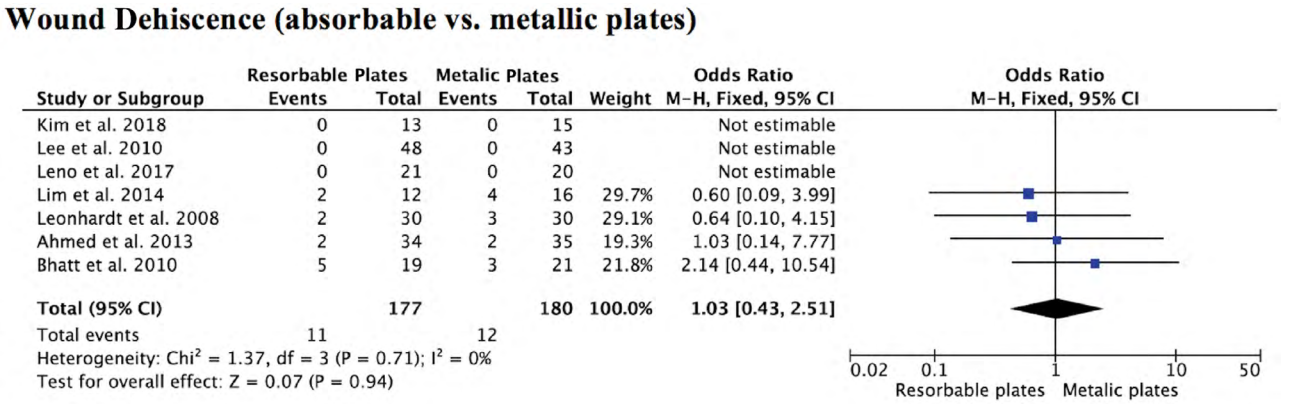

Fig. 4. Forest plot comparing the rate of wound dehiscence between the metallic and resorbable groups

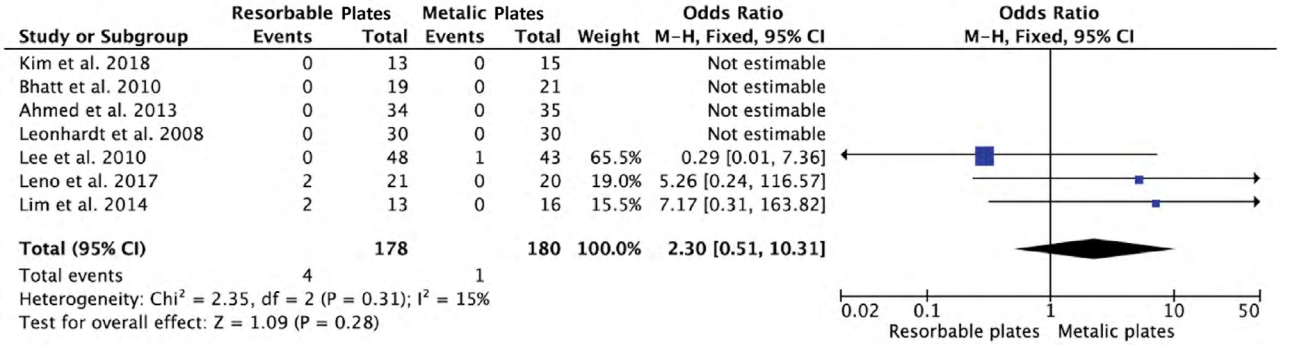

Fig. 5. Forest plot comparing the rate of hardware failure between the metallic and resorbable groups

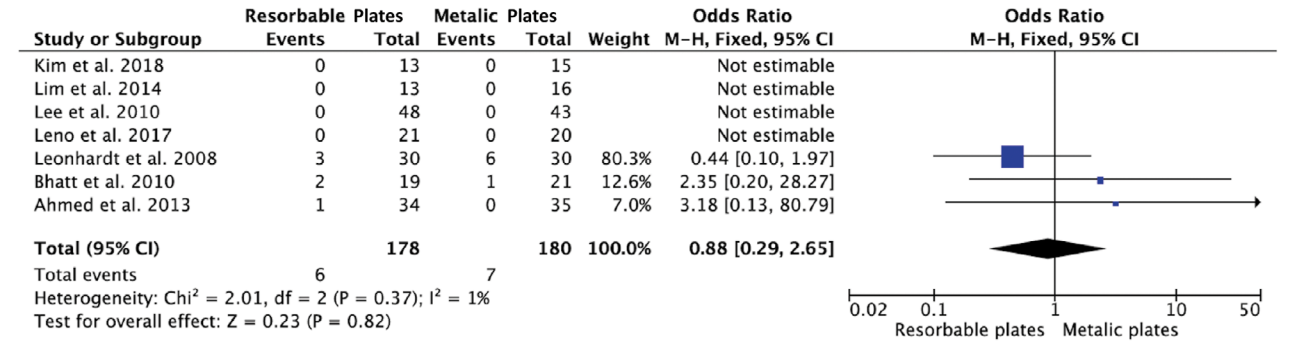

Fig. 6. Forest plot comparing the rate of malocclusion between the metallic and resorbable groups

DISCUSSION

Mandibular fractures most commonly require rigid fixation to ensure proper occlusion and adequate fracture stabilization. Metallic devices have been historically used for fixation, but due to concerns regarding the need for revision surgery for hardware removal and possible peri-implant reactions, resorbable materials emerged as a potential alternative.[6–8] Initial resorbable materials were, however, challenged on the basis of their ability to provide necessary tensile strength for fracture stabilization and issues regarding prolonged degradation rates.[12,13] There have since been significant developments in bioabsorbable polymers, which have led many to assess their efficacy for fixation of facial fractures, which have shown promising results.[32–34] Given that mandibular fractures represent one of the most common patterns for adult craniofacial skeleton fractures and the possible benefits associated with avoiding metallic implants, we sought to assess whether resorbable materials are a viable alternative.[1,8]

To our knowledge, the literature is devoid of meta-analyses comparing resorbable and metallic plates for mandibular ORIF. For this reason, a subset meta-analysis of prospective cohort studies and randomized trials comparing outcomes between metallic and resorbable materials was carried out. Overall, 178 patients were identified in the metallic groups and 180 patients were in the resorbable groups with pooled complication rates of 18.0% and 18.3%, respectively. The meta-analysis did indeed reveal that there is no measurable statistical difference (95% CI 0.58, 1.82, $P = 0.93$) across all included outcomes between metallic and resorbable implants. Specifically, there was no statistical difference between both groups in terms of the rate of postoperative infection, wound dehiscence, hardware failure, and malocclusion. Given these results, the meta-analysis suggests that there is no evidence of superiority in terms of outcomes based on implant type (resorbable versus metallic). Resorbable materials appear to be a viable alternative with evidence of statistically similar outcomes to metallic implants.

Overall complication rates of metallic implants used for mandibular fractures have been reported between 7% and 29% in the literature.[1,35–37] The current review assessed 18 primary studies evaluating the use of bioabsorbable materials for mandibular fractures, yielding an overall pooled complication rate of 19.8%. Gutta et al. carried out a retrospective study assessing complication rates for 363 patients managed with metallic devices for mandibular fractures.[38] The authors reported an overall complication rate of 26.45% with hardware failure (15.4%) being the most common adverse event.[38] Nagase et al. assessed long-term outcomes of patients requiring fixation for facial fractures with titanium plates. In their analysis, 48 patients had mandibular fractures and they reported a complication rate of 12.5% leading to plate removal, with infection being the most common adverse event.[39] Similarly, postoperative infection was the most common adverse event (6.8%) encountered in the current review for the subset of patients treated with resorbable plates (n = 455). However, the rate of revision surgery in our analysis is lower compared to the reported rate by Nagase et al.[39] Overall, 26 patients (5.7%) in the current review treated with resorbable implants required secondary surgery for hardware removal. Wound failure or infection leading to implant exposure occurred in 22 patients (4.8%), representing the most common cause for revision surgery. Of the 26 patients who underwent revision surgery, 7 (1.5% of the study cohort) required replacement with either titanium (n = 6) or resorbable (n = 1) plates. Postoperative plate fracture requiring replacement occurred in 2 patients (0.44%); 2 patients (0.44%) were noted to have nonunion, which necessitated replacement with a metallic implant; 2 patients (0.44%) had hardware exposure from wound dehiscence; and 1 patient (0.22%) had a fracture dislocation after removal of a dental impression, which necessitated replacement with a titanium plate. The remaining 19 patients (4.2%) had evidence of adequate fracture union and did not require implant replacement at the time of hardware removal.

Agarwal et al. carried out a systematic review in 2009 assessing the use of resorbable materials for the fixation of mandibular fractures and bilateral sagittal split osteotomies.[40] The authors reported an overall complication rate of 13.8% (n = 34/326) with infection (n = 14, 4.3%), malocclusion (n = 9, 2.8%), and malunion (n = 8, 2.5%) being the most commonly encountered adverse events. Due to the absence of randomized controlled trials at the time, the authors were unable to carry out meaningful statistical testing and therefore reported their data descriptively. Our systematic review and meta-analysis add to the findings of Agarwal et al. and strengthen the conclusion that resorbable materials are a viable alternative to metallic devices, with comparable complication rates and functional outcomes.

Due to paucity of data, stratification based on fracture location could not be included in the meta-analysis. We represented these data in Table 3 for descriptive purposes. The stratification according to fracture type revealed that isolated body and symphyseal fractures had the highest rates of adverse events. In contrast, for mandibular fractures treated with metallic plates, isolated angle fractures have been associated with the highest rates of postoperative complications.[41] Of note, different numbers of miniplates and periods of mandibulomaxillary fixation (MMF) were used across the included studies reporting on outcomes for angle fractures. Therefore, our finding that isolated angle fractures do not represent the pattern with the highest complication rate may be due to these confounding factors (length of MMF and number of miniplates) and cannot definitively be attributed to the fact that resorbable materials were used.

Our review identified BiosorbFX (Bionx Ltd, Tampere, Finland) (38.5% of fractures) and INION [(Inion, Tampere, Finland) or INION (Striker, Germany)] (21.5% of fractures) as the most commonly used resorbable materials. The majority of the absorbable implants identified in the current study come from various mixtures of polyglycolic acid and the D and L enantiomers of polylactic acid. Initial monomeric absorbable materials such as L enantiomer of polylactic acid were shown to have prolonged degradation rates, which led to reports of delayed foreign-body reactions at the peri-implant site.[11,13] As a result, multiple copolymers of polylactic acid and polyglycolic acid were developed to improve the rates of hydrolysis and biodegradation.[11] Self-reinforced polymers such as BiosorbFX and INION were later developed and carry the advantage of having increased strength compared to nonreinforced polymers (i.e., Lactosorb) and are moldable at room temperature.[11,42] Self-reinforcing polymers have been shown to have a wide array of applications in orthognathic surgery, oncologic reconstruction, and craniofacial trauma.[17] They have also been shown to provide adequate strength during the critical period for bone healing (6–8 weeks) while having complete degradation by 2–3 years postoperatively, reducing the likelihood of delayed inflammatory reactions.[42,43] The specific molecular orientation in self-reinforcing polymers provides increased strength of the composites, which allows for a thinner implant compared to nonreinforced polymers. This in turn reduces the

likelihood of developing implant palpability, which would necessitate hardware removal.[13] Similar to the trend of improving outcomes for mandibular ORIF with resorbable implants, hand surgery has seen a comparable shift. Early studies assessing resorbable implants for hand ORIF reported high complication rates due to peri-implant reactions.[43] In contrast, more recent studies assessing the use of advanced copolymers have reported similar outcomes compared to metallic devices.[43] Recently, Chu et al. have compared 4 types of absorbable plates (INION, Polymax, Osteotrans, and Biosorb) for the fixation of zygomaticomaxillary complex fractures.[44] The authors concluded that all 4 implant types are adequate for fixation of zygomaticomaxillary complex fractures. However, they found that the self-reinforcing properties of Biosorb offered a thinner implant (0.8 mm for Biosorb compared to 1.4–1.5 mm for INION/Polymax/Osteotrans) with lower rates of palpability compared to their counterparts. In contrast, they found that Biosorb offered lower strength compared to the other implants, making Bisorob less suitable for severely comminuted fractures. In the current review, there were no prospective studies stratifying outcomes according to the specific resorbable implant used. Therefore, on the basis of this analysis, conclusions cannot be drawn as to the specific resorbable implant that is superior in the management of mandible fractures.

Our conclusions are mainly limited by the paucity of large randomized controlled trials with long follow-up periods comparing outcomes for patients managed with metallic and resorbable implants across similar fracture patterns. The absence of standardized objective measures between studies to quantify postoperative occlusion or fracture mobility also limits the accuracy of our reported functional outcomes. Potential confounders in the current analysis include surgeon expertise, varying operative techniques (load-bearing and load-sharing techniques both included), and the length of postoperative MMF. We recognize that our pooled cohort represents a heterogeneous population with varying fracture distributions, which may limit our comparison to studies reporting on metallic implants. Given the absence of large studies comparing patients with identical fracture patterns, a subset analysis was not possible. Therefore, resorbable implants associated with higher complication rates (Lactosorb and INION) may have been used across more complex fracture patterns compared to their counterparts. As a result, on the basis of this review, recommendations cannot be made as to the specific resorbable implant associated with the lowest complication rates. Of note, in the majority of the included studies with control groups, the thicknesses of the resorbable implants (range, 1.5–2.5 mm) were similar to those of metallic devices (range, 2.0–2.5 mm), which further strengthens the conclusions of our meta-analysis, limiting any potential confounders associated with varying implant width.

We are also aware that a meta-analysis including a larger amount of prospective randomized trials would strengthen the validity of our conclusions. Given the current status of the literature, however, there is no evidence to support the superiority of one device over the other, but we recognize that larger trials are necessary to draw more robust conclusions. With these limitations in mind, we encourage craniofacial surgeons to reflect on their own practices and patient-specific profiles before adopting our conclusions to offer safe and efficient care.

CONCLUSIONS

Given the recent interest and benefits associated with bioabsorbable copolymers, we sought to assess the efficacy of resorbable implants as a viable alternative for the fixation of mandibular fractures. The meta-analysis suggests that there are no statistical differences in perioperative and functional outcomes for patients with mandible fractures managed with resorbable or metallic implants. Further large prospective randomized trials are necessary to definitively prove causality in an effort to offer generalizable recommendations to craniofacial surgeons. In the absence of meta-analyses or large randomized controlled trials, the current study provides surgeons with an evidence-based reference to guide decision-making.

Alain Azzi, MD, MSc
Division of Plastic & Reconstructive Surgery
McGill University Health Centre 1001 Decarie Blvd
Montreal, QC, Canada H4A 3J1
E-mail: alain.azzi@mail.mcgill.ca

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