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Accuracy of Different Sequencing in Bimaxillary Orthognathic Surgery: A Systematic Review and Meta-analysis

Thatchawee Borikanphanitphaisan
Graduate Institute of Dental and Craniofacial Science, Chang Gung University, Taoyuan, Taiwan

Ellen Wen-Ching Ko
Graduate Institute of Dental and Craniofacial Science, Chang Gung University, Taoyuan, Taiwan; Craniofacial Research Center, Chang Gung Memorial Hospital, Linkou, Taiwan; 3Department of Craniofacial Orthodontics, Chang Gung Memorial Hospital, Taipei, Taiwan, ellenko.wc@msa.hinet.net

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ACCU RACY OF DIFFERENT SEQUENCING IN BIMAXILLARY ORTHOGNATHIC SURGERY: A SYSTEMATIC REVIEW AND META-ANALYSIS

Thatchawee Borikanphanitphaisan, 1 Ellen Wen-Ching Ko 1,2,3
1 Graduate Institute of Dental and Craniofacial Science, Chang Gung University, Taoyuan, Taiwan
2 Craniofacial Research Center, Chang Gung Memorial Hospital, Linkou, Taiwan
3 Department of Craniofacial Orthodontics, Chang Gung Memorial Hospital, Taipei, Taiwan

Introduction: Compared to the classic maxilla-first sequence in bimaxillary orthognathic surgery, inverted mandible-sequence has been encouraged for potentially higher accuracy. However, evidence regarding this topic is lacking. Methods: A systematic review of the literature on different sequencing of bimaxillary surgery was conducted, gathering from following databases: Cochrane, Pubmed, Scopus, Medline (Ovid), Web of Science, ScienceDirect. Articles mentioning “sequencing”, “mandible-first”, “orthognathic surgery” of at least case-report level of evidence were included without restriction. Relevant articles were included for quality assessment and extracted data for indications of mandible-first sequence from all studies. Meta-analysis of surgical accuracy at upper central incisors in horizontal and vertical dimension was performed from included experimental studies. Results: The search of initially 619 articles resulted in 9 final articles: 6 case reports and 3 experimental studies. The four most commonly listed indications for mandible-first approach included instability of condylar centric relation (CR) position, posterior maxillary downgrafting, when rigid fixation of maxilla cannot be ascertained, and large maxillomandibular advancements. The pooled analysis of experimental studies composed of 188 patients (122 females, 66 males). Quality assessment of these studies resulted as moderate. Meta-analysis revealed no difference of surgical accuracy between both sequencing, with considerable heterogeneity. Conclusion: Mandible-first approach has been advocated under certain indications, in order to reduce potential jaw repositioning error and ease of surgical manipulation. Differences were not found in maxilla repositioning at central incisors, horizontally and vertically between both approaches. However, the results should be taken with caution because of heterogeneity in study design and outcome measurements. (Taiwanese Journal of Orthodontics. 31(1): 12-23, 2019)

Keywords: bimaxillary orthognathic surgery; maxilla-first approach; mandible-first approach.
INTRODUCTION

One of the determinants to success of treating dentofacial deformities with orthognathic surgery (OGS) is the ability to reproduce the treatment plan during operation. Back in the 1960s, when the early successful simultaneous bimaxillary jaw surgeries were carried out by Obwegeser, both maxilla and mandible were osteotomized and freed simultaneously, then wired together at the dentition part, and subsequently mobilized as the whole maxillomandibular complex and fixated to the desired position, solely based on surgeon’s subjective judgement.

Later, the model surgery method, in combination with acrylic interocclusal splints were developed as a measure to surgical planning and transferring to operation more objectively. Model surgery allows rehearsal of the operation once in the stone models were mounted in articulator. The plan was transferred to the operation with predictability by means of intermediate splint and final splint (double-splint method). In this manner, bimaxillary surgery needs to be completed one at a time, relying on the intermediate stent fitting onto the other unoperated jaw as reference. At this point, the issue of operation sequencing arises and have remained controversial for decades, as of which jaw to operate first; maxilla-first or mandible-first. Traditionally, maxilla-first sequence was practiced and passed on in the days when wire osteosynthesis was the only option to fixate jaws. The reposition of distal segment of mandible could only be made through intermaxilllary fixation (IMF) wiring for duration long enough for bony union with the corresponding proximal segments. Thereafter, the advent of rigid internal fixation system, with plates and screws, had opened the possibility of mandible-first sequence. Regardless of the sequence of jaw operation, it is mandatory that the first jaw is repositioned with accuracy, because it then becomes the reference for the reposition of the other jaw.

Until recently, the literatures advocating on mandible-first sequence raised the common concern on unreliability of mandibular position in certain conditions. Since mandible is attached to the skull base with movable joints (condyles), as opposed to the maxilla being attached more rigidly to the skull base, and therefore, maxilla should potentially serve better as a reference for the first-operated jaw (mandible). However, under situation in which mandibular position can be reproduced with certainty both during examination and operation, it should be practically feasible to operate mandible-first sequence with the same accuracy as classical maxilla-first sequence. A literature review covering this topic produced only relative indications in which mandible-first sequence was advisable. The experimental study-based evidence should be able to answer this topic in a more objective way, and to bring this long-time debate to a common ground.

The aim of the present systematic review was to analyze the current indications on inverted mandible-first sequence, and to compare the accuracy of surgical outcome relative to the virtual/model surgical planning in both maxilla-first and mandible-first approach.

MATERIALS AND METHODS

Inclusion of studies in this systematic review was performed according to PRISMA guidelines (Figure 1), and the main research question was defined in PICO format (Table 1)

SEARCH STRATEGY AND STUDY SELECTION

An electronic search of six sources of database; Cochrane, Pubmed, Scopus, Medline (Ovid), Web of Science, and ScienceDirect was performed up to February 2019. All publications with title in English were included without restriction on type of study. Inclusion criteria included any mention regarding “jaw operation sequence”
or “mandible-first” approach within the title or abstract. Exclusion criterion was expert opinion without providing any case samples. Regarding study selection in this systematic review, at least studies with level of evidence of case series/case reports was selected. In the studies with case-control experimental level of evidence or above, sample size of less than 10 were excluded.

The search strategy was carried out to include two categories of headings; (1) terms related to bimaxillary orthognathic surgery (“bimaxillary” OR “orthognathic surgery” OR “two-jaw” OR “double-jaw” OR “surgical orthodontic”) and (2) terms related to sequencing of jaw operation (“sequencing” OR “jaw sequencing” OR “maxilla-first” OR “maxilla first” OR “mandible-first” OR “mandible first”). The searching operation “OR” was applied for the terms under the same category, and finally the operation “AND” was applied to join both categories of terms in searching algorithm.

The search strategy was applied by one investigator (T.B.) and both investigators (T.B., E.W.C. K.) independently performed the screening of the title and abstracts. Abstracts were selected according to the inclusion criteria. Those articles that abstracts satisfied the criteria were then obtain in full-text. The full-texts were thoroughly evaluated for final inclusion. In case of any difference in the final included list of eligible studies, a discussion to reach consensus decision was made.
Incomplete outcome data, 6) selective reporting, and 7) other potential types of bias.

The quality of case-control experimental studies is assessed with the modified Newcastle-Ottawa scale\(^7\) for intervention-type that compares different treatment protocols. The scoring is composed of 3 sections

1. “Selection” evaluation case definition, representativeness of cases, control selection, and definition of controls. Each aspect is scored 1 point, giving 4 points in total

2. “Comparability” clear specification of the primary outcome control, plus additional 1 point for statement of control for additional factor, giving 2 points in total

3. “Outcome assessment” evaluation of outcome measures, treatment changes, and blinding of assessors. In total, 3 points could be obtained in this section.

### SUMMARY MEASURES AND APPROACH TO SYNTHESIS

The primary outcome of interest in this review, the surgical outcome error, was defined by difference between surgery-planning image and actual surgery outcome, measured at any spatial point of interest. The point of interest could be anatomical landmarks or arbitrary points calculated by 3D virtual planning software. The surgical outcome error is inversely related to the surgical outcome accuracy mentioned in PICO (Table 1). In other words, the less of surgical outcome error, the more favorable outcome of the sample group, and vice-versa.

**Table 1. The PICO format of article search for surgical sequence in two-jaw orthognathic surgery.**

<table>
<thead>
<tr>
<th>Population</th>
<th>Subjects with facial deformities requiring bimaxillary orthognathic surgery, with double-splint method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intervention</td>
<td>Inverted Mandible-first sequencing</td>
</tr>
<tr>
<td>Comparison</td>
<td>Classic Maxilla-first sequencing</td>
</tr>
<tr>
<td>Outcome</td>
<td>Surgical outcome accuracy</td>
</tr>
</tbody>
</table>

DATA EXTRACTION

For the case series/case reports level of studies, the data extracted were year of publication, and the indications in which performing mandible-first sequence is advantageous. For the experimental level of studies, the following data were extracted: year of publication, sample size, sex distribution, type of facial deformity before surgery, surgical planning protocol, type of transferring method and jaw fixation, reason for mandible-first sequence, success criteria, actual surgical outcome accuracy (reported in term of error/discrepancy between planning image and actual surgical outcome image).

QUALITY ANALYSIS ASSESSMENT

The quality analysis of the study was applied for the risk of bias in research article/experimental type of study. The selection of the quality analysis tools was planned as follows; the Cochrane Collaboration Risk of Bias Tool\(^5\) for the randomized experimental study, and the Newcastle-Ottawa scale\(^6\) for non-randomized experimental study. In case of any discrepancy findings between both investigators, a discussion to reach consensus decision was made.

The Cochrane Collaboration tool for risk of bias assessment in randomized controlled trials investigates on these following domains: 1) random sequence generation, 2) allocation concealment, 3) blinding of participants and personnel, 4) blinding of outcome assessment, 5) Incomplete outcome data, 6) selective reporting, and 7) other potential types of bias.

The quality of case-control experimental studies is assessed with the modified Newcastle-Ottawa scale\(^7\) for intervention-type that compares different treatment protocols. The scoring is composed of 3 sections

1. “Selection” evaluation case definition, representativeness of cases, control selection, and definition of controls. Each aspect is scored 1 point, giving 4 points in total

2. “Comparability” clear specification of the primary outcome control, plus additional 1 point for statement of control for additional factor, giving 2 points in total

3. “Outcome assessment” evaluation of outcome measures, treatment changes, and blinding of assessors. In total, 3 points could be obtained in this section.
Random-effects meta-analysis was performed for the surgical error (accuracy) at central incisors in both vertical and horizontal dimension. In case of studies reporting surgical errors in multiple subgroups concerning the direction of the surgical movement, the mean and standard deviation of subgroups were calculated for pooled mean and pooled standard deviation, yielding the pooled representative value of such study for further meta-analysis calculation. Overall effect difference was set at significant level of $P < 0.05$. Results of the analyses are displayed with forest plots. The heterogeneity of data was evaluated by $I^2$ statistics. All calculations were done with RevMan - Review Manager software (version 5.3; The Nordic Cochrane Centre, The Cochrane Collaboration).

**RESULTS**

**Included studies and data extraction**

The PRISMA flow diagram (Figure 1) displaying the initially retrieved 619 articles, after removal of duplicates, resulted in 283 articles for further assessment. Subsequently, 11 articles were eligible for full-text evaluation. Among these, two of the articles were excluded because one being non-double-splint method, and the other one was based on the same patient group. Therefore, total of 9 articles were finally included in this systematic review. In this list, there were 6 case reports and 3 research articles of case-control type (Table 2).

A summary of the indications for mandible-first orthognathic surgery were gathered from the list and is given in Table 3. The demographic data of the pooled patient sample, from the three case-control studies, is given in Table 4. Altogether, 188 patients were included: 122 females and 66 males. There were 94 patients underwent mandible-first sequencing, whereas 94 patients belonged to the control group, having underwent maxilla-first sequencing. Regarding the mean age, Ritto et al. did not specify mean age of the samples. The calculated pooled mean age of the other two studies were as follows: mean age of patients in maxilla-first sequence group was 28.25 years, and 27.57 years in the mandible-first sequence group. One study specified the type of dentofacial deformity include in their study: presence of vertical maxillary excess.

<table>
<thead>
<tr>
<th>Authors</th>
<th>Year</th>
<th>Study type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lindorf and Steinhauser</td>
<td>1978</td>
<td>Case report</td>
</tr>
<tr>
<td>Cottrell and Wolford</td>
<td>1994</td>
<td>Case report</td>
</tr>
<tr>
<td>Posnick et al.</td>
<td>2006</td>
<td>Case report</td>
</tr>
<tr>
<td>Perez and Ellis</td>
<td>2011</td>
<td>Case report</td>
</tr>
<tr>
<td>Ritto et al.</td>
<td>2014</td>
<td>Research article</td>
</tr>
<tr>
<td>Perez and Ellis</td>
<td>2016</td>
<td>Case report</td>
</tr>
<tr>
<td>Iwai et al.</td>
<td>2016</td>
<td>Case report</td>
</tr>
<tr>
<td>Iwai et al.</td>
<td>2017</td>
<td>Research article</td>
</tr>
<tr>
<td>Salmen et al.</td>
<td>2017</td>
<td>Research article</td>
</tr>
</tbody>
</table>
### Table 3. Summary of Indication for the inverted sequence (Mandible-first) bimaxillary orthognathic surgery.

<table>
<thead>
<tr>
<th>Author and year of publication</th>
<th>Indication for Mandible-first sequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lindorf and Steinhäuser, 4 1978</td>
<td>Advised to use as routine approach without specific indication</td>
</tr>
</tbody>
</table>
| Cottrell and Wolford, 11 1994 | 1. Maxilla possessing thin bony wall  
2. Large mandibular advancements |
| Posnick et al., 12 2006 | 1. Unstable CR position (due to conditions affecting condyle or masticatory muscles e.g. hemifacial microsomia, trauma, pathology, neuropsychiatric-related muscle spasticity)  
2. Large posterior maxillary lengthening |
| Perez and Ellis, 17 2011 and Perez and Ellis, 15 2016 | 1. Segmentalization of maxilla/cleft maxilla  
2. Counterclockwise rotation of maxillomandibular complex and downgrafting of maxilla  
3. Large maxillomandibular advancements  
4. Anterior open bite  
5. Concomitant temporomandibular joint surgery  
6. Unstable bite registrations/ CO-CR discrepancy |
| Ritto et al., 8 2014 | To reduce mandible-related error e.g. unreliable bite registration and CR registration |
| Iwai et al., 14 2016 | Posterior maxillary downgrafting |
| Liebregts et al., 9 2017 | Not specified |
| Salmen et al., 10 2017 | Not specified |

CR, centric relation position of the mandible; CO, centric occlusion position/ maximal Intercuspal position of the mandible.

### Table 4. Demographic data for the studies included, on Maxilla-first and Mandible-first approach comparison.

<table>
<thead>
<tr>
<th>Author, year</th>
<th>Type of study</th>
<th>Sample</th>
<th>Mean age, years</th>
<th>Gender</th>
<th>Type of Facial deformity</th>
</tr>
</thead>
</table>
| Ritto et al., 2014 | Retrospective case-control | n = 40 (Mx-first = 20  
Md-first = 20) | N/S | 17M, 23F | N/S |
| Salmen et al., 2017 | Retrospective, case-control | n = 32 (Mx-first = 16  
Md-first = 16) | Mx-first = 26.96  
Md-first = 27.81 | 13M, 19F | Vertical Maxillary Excess |
| Liebregts et al., 2017 | Retrospective, case-control | n = 116 (Mx-first = 58  
Md-first = 58) | Mx-first = 28.6  
Md-first = 27.5 | 36M, 80F | N/S |

Mx-first, maxilla-first sequence; Md-first, mandible-first sequence.
Summary on methodology and major findings were extracted from the three case-controls and tabulated in Table 5. Two studies used model surgery planning and two-dimensional (2D) radiographs for surgical planning and splint fabrication, whereas the other study, by Liebregts et al., used three-dimensional (3D) CBCT images and virtual software simulation for both purposes. All studies used double-splint technique as the measure to transfer planning to the actual operation. Ritto et al. specified the success criteria of good accuracy with the numeric threshold suggested by the past review. The evaluation of the accuracy outcome and measurement parameters were reported in Table 6. There were variety in aspects of 1) selection of landmarks for measurements; 2) type of radiographic image and planning method; 3) type of transferring method and fixation; 4) reason for mandible-first approach; 5) success criteria; and 6) major finding on actual outcome accuracy.

Table 5. Methods and Findings of the studies included, on Maxilla-first and Mandible-first approach comparison.

<table>
<thead>
<tr>
<th>Author, year</th>
<th>Radiographic image, and Planning method</th>
<th>Type of transferring method, and fixation</th>
<th>Reason for mandible-first approach</th>
<th>Success criteria</th>
<th>Major finding on Actual outcome accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ritto et al., 2014</td>
<td>2D, Model surgery</td>
<td>Double-splint, Miniplate fixation</td>
<td>To reduce mandibular-related errors, bite record, centric relation</td>
<td>Surgical error Horizontally &lt; 2mm Vertically &lt; 1 mm</td>
<td>Mx-first: Maxilla vertical error = 0.91 mm horizontal error = 1.34 Md-first: 1.01 mm, horizontal error = 1.04 mm No significant difference between both approaches</td>
</tr>
<tr>
<td>Salmen et al., 2017</td>
<td>2D, Model surgery</td>
<td>Double-splint, mandibular hybrid fixation</td>
<td>N/S</td>
<td>N/S</td>
<td>Mx-first yield better accuracy of A-point and U1 vertically. Md-first yields better accuracy of Pogonion vertically.</td>
</tr>
<tr>
<td>Liebregts et al., 2017</td>
<td>3D, Virtual planning (Maxilim software)</td>
<td>Double-splint, mandibular hybrid fixation</td>
<td>N/S</td>
<td>N/S</td>
<td>For anterior movements, Mx-first yielded better accuracy. For CW pitch rotational planned movement, Md-first yielded better accuracy.</td>
</tr>
</tbody>
</table>

Table 6. Evaluation of the accuracy outcome and measurement parameters.

<table>
<thead>
<tr>
<th>Author, year</th>
<th>Radiographic image, and Planning method</th>
<th>Type of radiographic images compared</th>
<th>Superimposition method</th>
<th>Landmarks selected for measurements</th>
<th>Measurement parameters presented</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ritto et al., 2014</td>
<td>2D, Model surgery</td>
<td>2D lateral cephalogram, hand-traced (pre-op VS post-op)</td>
<td>Made on Sella-Nasion (S-N) line</td>
<td>U1 (midpoint of incisal edge of maxillary incisor)</td>
<td>Difference in Vertical coordinate and Horizontal coordinate of each landmark</td>
</tr>
<tr>
<td>Salmen et al., 2017</td>
<td>2D, Model surgery</td>
<td>2D lateral cephalogram, digitally traced in Dolphin software (pre-op VS post-op)</td>
<td>Made on point Sella (S) and point Nasion (N)</td>
<td>U1 tip (upper Incisor edge), U6 (upper first molar), A-point, ANS (anterior nasal spine), PNS (posterior nasal spine), L1 tip (lower incisor edge), L6 (lower first molar), Pg (Pogonion), B-point</td>
<td>Difference in Vertical coordinate and Horizontal coordinate of each landmark</td>
</tr>
<tr>
<td>Liebregts et al., 2017</td>
<td>3D, Virtual planning (Maxilim software)</td>
<td>3D CBCT, skull model rendered in Maxilim software (pre-op VS post-op)</td>
<td>Voxel-based registration made on anterior cranial base</td>
<td>U1, U6R (right upper first molar), U6L (left upper first molar), L1, L6R (right lower first molar), L6L (left lower first molar). Virtual triangles were constructed for each jaw.</td>
<td>Difference in 3 Translational directions and 3 Rotational directions reported, after translation of virtual triangle of jaws from pre-op image to post-op image</td>
</tr>
</tbody>
</table>
and 2) direction/dimension in which error was assessed, among three studies. The only parameter that all three studies had in common was measurement at central incisors (U1) in horizontal and vertical dimension. Therefore, this parameter was included for the meta-analysis.

Quality analysis assessment
Since no randomized clinical trials was included in this systematic review, Cochrane Collaboration tool was not applied. The assessment of the risk of bias for the three case-control studies with the modified Newcastle-Ottawa scale was presented in Table 7. All three studies obtained 4 points in the section of selection. For the Outcome assessment, the study of Ritto et al. missed 1 point due to the lack of specifying type of surgical movement of both experimental and control group. For comparability, all included studies scored 2 points, and the missing of 1 more point was due to absence of blinding of assessors.

Indications for mandible-first sequence
Seven articles discussed the potential indications of mandible-first sequence (Table 3), elaborating on specific circumstances in which operating on mandible-first could benefit by more ease of surgical manipulation by surgeon, less dependent on correct condylar CR registration and bite registration, less subject to errors from model surgery process, less affecting the rigidity of wire/plates and screws fixation of the first-operated jaw. The most frequently mentioned indication was instability of condylar CR position. Lindorf and Steinhäuser even advocated mandible-first to be routine practice because of unreliability of mandibular position, to serve as reference if maxilla is to be operate first. The second most stated indication was posterior maxillary downgrafting/lengthening, and/or counterclockwise rotation of maxillomandibular complex/occlusal plane. Additional indication was when fixating maxilla-first with rigidity could not be anticipated or could be jeopardized, for instance 1) Maxilla with thin bony wall, cleft defect, and planned segmentalization; and 2) large maxillomandibular advancements. In case of anterior open bite and concomitant temporomandibular joint (TMJ) surgery were also mentioned as potential indications.

Table 7. Newcastle-Ottawa quality assessment scale for the case-control experimental studies.

<table>
<thead>
<tr>
<th>Author and year of publication</th>
<th>Selection</th>
<th>Comparability</th>
<th>Outcome assessment</th>
<th>Newcastle-Ottawa scale outcome (range, 0 - 9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ritto et al., 2014</td>
<td>****</td>
<td>*</td>
<td>**</td>
<td>7</td>
</tr>
<tr>
<td>Liebregts et al., 2017</td>
<td>****</td>
<td>**</td>
<td>**</td>
<td>8</td>
</tr>
<tr>
<td>Salmen et al., 2017</td>
<td>****</td>
<td>**</td>
<td>**</td>
<td>8</td>
</tr>
</tbody>
</table>

* 1 point; ** 2 points; *** 3 points; **** 4 points.
Accuracy of actual surgical outcome: maxilla-first versus mandible-first

The mean difference and 95% confidence interval (95% CI) in surgical outcome error between maxilla-first and mandible-first sequence, measured at upper central incisors, was provided in Figure 2 for horizontal dimension, and in Figure 3 for vertical dimension respectively.

In horizontal dimension, there were no significant difference ($P = 0.20$ for overall effect) between both sequencing approaches. Statistical analysis of heterogeneity revealed $\tau^2 = 0.29$, Chi-square = 11.33 with $P = 0.003$, and $I^2 = 82\%$, which interpreted as considerable heterogeneity.

In vertical dimension, there were also no significant difference ($P = 0.40$ for overall effect) between both sequencing approaches. Statistical analysis of heterogeneity revealed $\tau^2 = 0.38$, Chi-square = 16.89 with $P = 0.0002$, and $I^2 = 88\%$, which also showed considerable heterogeneity across studies.

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**Figure 2.** Surgical Error at Upper Incisors in horizontal dimension: meta-analysis.

**Figure 3.** Surgical Error at Upper Incisors in vertical dimension: meta-analysis.
DISCUSSION

The sequence of bimaxillary orthognathic surgery has long been a topic of debate and remained controversial at present. As the pursuit toward surgical treatment outcome with more accuracy and predictability, the intention to investigate on this issue is reflected in more numbers of articles in recent years, especially of experimental study type rather than case reports or unsupported axioms. Following the first publication on this issue of inverted mandible-first sequence, majority of subsequent publications were case reports advocating the potential benefits of the approach. Potential superiority and indications were provided, but the consensus have not been reached. In this systematic review, the investigators aimed to summarize all aspects of indication regarding mandible-first approach, as well as to answer the question in a more evidence-based manner with clinical studies. However, this article encountered the absence of any randomized controlled trial type of study, according to the PRISMA flow diagram. Hopefully, soon, there will be growing number of experimental studies of higher level of evidence in this field, so that this question could be demystified with universal agreement.

The heterogeneity of the selected experimental studies has allowed for meta-analysis of accuracy of surgical outcome of only one landmark (at upper central incisors), despite the fact that recent studies provided measurements at various landmarks, encompassing dental as well as underlying skeletal parts. Difference in radiographic method among studies contributed partly to this. 2D radiographs has the major drawback of inability to reveal measurement in transverse dimension distinctly. Whereas the 3D-based radiography and virtual planning offers the inspection of the skull from any aspect readily, as well as data in transverse dimension and all rotational displacements (pitch, roll, yaw) without projection distortion. Liebregts et al. provided the most abundant data via 3D-based virtual software planning, with most of them left unused in this analysis because the other two studies, had no corresponding data to compare with. In other words, there might be other differences in details between both sequencing approach, such as accuracy at other landmarks, as well as accuracy in transverse dimension, pending to be discovered after more 3D-based studies become more available. Therefore, increasing number of studies utilizing 3D-based radiography would allow us to appreciate better the accuracy of surgical outcome, of the entire maxilla and mandible, rather than from a specific point.

Nonetheless, central incisors’ position is one of the most important, readily visible landmarks by patient and surgeon-orthodontist personnel after surgery. Therefore, accuracy at this landmark is critical to success and patient’s satisfaction. In addition, this meta-analysis has concluded that the accuracy, produced at upper central incisors, were not different between both approaches. This finding suggests that regardless of sequencing, if the plan-transferring method and surgical manipulation is decent, then favorable outcome could be anticipated. The existing evidence at hand inclines to the suggestion that mandible-first sequencing is more of a preference settled by preoperative planning and surgeon’s expertise, rather than obligate indication.

CONCLUSION

Mandible-first approach has been advocated under certain indications, in order to reduce potential jaw repositioning error and ease of surgical manipulation. Differences were not found in maxilla repositioning at central incisors, horizontally and vertically, between maxilla-first and mandible-approach. However, the results should be taken with caution because of heterogeneity in study design and outcome measurements.
REFERENCES


