

# Comparison of the clinical outcomes of Scarf and Chevron Osteotomy for Hallux Valgus Deformity: a meta-analysis of randomized controlled trial

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## Research article

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## Abstract

Background Scarf and Chevron Osteotomy have been widely used for Hallux Valgus Deformity(HVD) to correcting hallux valgus angle (HVA) and intermetatarsal 1-2 angle (IMA), but there still have controversy which approach is the best way to repair HVD, this study aims to use meta-analysis to evaluate the clinical outcomes of Scarf and Chevron Osteotomy for Hallux Valgus Deformity. Methods Pubmed, Embase, Medline and Cochrane library databases were searched for relevant studies published before September 1, 2019. Studies clearly reporting a comparison of Scarf and Chevron Osteotomy for Hallux Valgus Deformity were selected. The Post-operative hallux valgus angle (HVA) and intermetatarsal 1-2 angle (IMA) were evaluated and also the correction of HVA and IMA. The weighted mean differences and relative risks were calculated using a fixed-effects or random-effects model. Results Five studies were included in this meta-analysis, one were prospective randomized controlled trials and three were randomized control trials. A total of 434 patients (210 Scarf and 224 Chevron) were enrolled in the studies. Compare Scarf Osteotomy, Chevron Osteotomy can significantly decrease Post-operative hallux valgus angle (HVA) [MD = 1.92, 95% CI (1.21 to 2.63), P < 0.0001], but there have no significantly difference between Scarf and Chevron Osteotomy groups in terms of Postoperative intermetatarsal angle (IMA), the correction of IMA and HVA (C-IMA/HVA), DMAA, AOFAS and complication incidence [MD = 0.42, 95% CI (-0.34 to 1.17), P = 0.28; MD = -0.30, 95% CI (-0.72 to 0.12), P = 0.16; MD = -0.88, 95% CI (-2.34 to 0.57), P = 0.23; MD = -0.78, 95% CI (-2.29 to 0.72), P = 0.31; MD = -2.01, 95% CI (-9.81 to 5.61), P = 0.59 and OR = 0.80, 95% CI (0.40 to 1.60), P = 0.53 respectively]. Conclusion Compare Scarf osteotomy, Chevron Osteotomy can significantly decrease Post-operative hallux valgus angle (HVA) and other clinical outcomes are similar between the two treatments.

## Background

As we all know Hallux Valgus Deformity(HVD) could be associated with persistent foot pain and result in foot dysfunction, which could increased the risk of osteoarthritis (OA) at the first metatarsophalangeal joint, hallux valgus is a highly prevalent foot deformity estimated to affect 23% of adults and 35.7% of elderly individuals.<sup>1-4</sup> Numerous techniques include operation and non-operation methods have been described in the past decades to improve the patient's foot function and correct hallux valgus.<sup>5,6</sup> Although the selection of the method mostly depends on the severity of hallux valgus deformity, but Scarf and Chevron Osteotomy is become more and more popularised to repair HVD, a lot of previous studies have demonstrated that both Scarf and Chevron Osteotomy have positive effect on postoperative HVA and IMA.<sup>7,8</sup> However, there is a lack of consensus regarding which method is the better choice to repair HVD. So this study aims to use meta-analysis to evaluate the clinical outcomes of Scarf and Chevron Osteotomy in HVD surgery, in order to prevent the accuracy of the result, only randomized controlled trials(RCT) or prospective-RCT were included in final analysis.

## Methods

### Search strategy

Pubmed, Embase, Medline and Cochrane library were searched independently by two investigators to retrieve relevant studies published before September 1, 2019. The search criteria "Scarf", "Chevron", "Osteotomy" and "Hallux Valgus Deformity" were used in key word searches. All studies selected were reviewed independently by the authors and examined for broadening the potential studies through the "related articles" function. Thus, the reference lists of the included articles were also manually checked to find relevant studies that were not found during the database searches.(Fig 1.)

**Inclusion Criteria:** 1. Osteotomy procedure was used for hallux valgus deformity, not for other diseases. 2. Study type was randomized controlled trials(RCT). 3. Follow-up examination must include any one among the HVA,C-HVA,IMA,C-IMA,DMMA,AOFAS and complication outcomes.

**Exclusion Criteria:** 1. Osteotomy procedure was used for trauma or tumor diseases. 2. Not Randomized controlled trials(RCT) or prospective-RCT, include retrospective trials. 3. Animal or laboratory study.

## Data Extraction

Each article's variables and outcomes of interest and assessment of the methodological quality were reviewed independently by two readers. If there was a difference of opinion, the problems were resolved through discussion and consensus. The methodological quality of the trials was assessed through the Cochrane Handbook for Systematic Reviews of Interventions 5.1.

## Statistical Analysis

The statistical analysis was performed using Review Manager 5.1 for Windows System (Cochrane Collaboration, Nordic Cochrane Centre, Copenhagen, Denmark). Categorical dichotomous variables were analyzed with relative risks (RRs), continuous variables were assessed with the weighted mean difference, and  $P < 0.05$  was considered statically significant; the 95% confidence intervals (CIs) were reported. Heterogeneity was considered significant if the  $P$  value was less than 0.1. The value of  $\hat{\tau}^2$  statistics was used to assess the degree of heterogeneity ( $\hat{\tau}^2 < 25\%$ , no heterogeneity;  $\hat{\tau}^2 = 25\text{--}50\%$ , moderate heterogeneity;  $\hat{\tau}^2 > 50\%$ , large or extreme heterogeneity); if  $\hat{\tau}^2 > 50\%$ , a fixed-effects model was used. The presence of publication bias was assessed by a visual inspection of a funnel plot and the Begg and Egger tests (with  $P < 0.05$  considered statistically significant).

# Results

## Literature Search

The initial literature search retrieved 67 relevant articles (duplicates were discarded). After a careful screening of the titles, 25 articles were excluded for not investigating the topic of interest. After reviewing the abstracts, 35 articles were excluded, leaving 7 studies for further full publication review. One study was excluded because it's retrospective article and one for the format of continuous variables outcome were not  $\text{mean} \pm \text{SD}$ . Therefore, five studies matched the selection criteria and were suitable for meta-analysis.<sup>9</sup>

<sup>13</sup> They are all randomized control trials(Figure 1), a total of 434 patients (210 Scarf and 224 Chevron)

were enrolled in the studies. The information of the included studies is summarized in Table 1. Among the included studies, all investigated the postoperative HVA,IMA and complication events,three studies reported the correction of HVA and IMA,two studies reported DMMA,AOFAS outcomes.

## Main Analysis

Compare Scarf Osteotomy,Chevron Osteotomy can significantly decreaseed Post-operative hallux valgus angle (HVA)[MD = 1.92 95 % CI (1.21 to 2.63),P < 0.0001],but there have no significantly difference between Scarf and Chevron Osteotomy groups in terms of Postoperative intermetatarsal angle (IMA),the correction of IMA and HVA(C-IMA/HVA),DMAA,AOFAS and complication incidence[MD = 0.42, 95 % CI (-0.34 to 1.17),P=0.28;MD = -0.30, 95 % CI (-0.72 to 0.12),P =0.16; MD = -0.88, 95 % CI (-2.34 to 0.57),P =0.23;MD = -0.78, 95 % CI (-2.29 to 0.72),P =0.31;MD = -2.01, 95 % CI (-9.81 to 5.61),P =0.59 and OR=0.80, 95% CI (0.40 to 1.60),P=0.53 respectively].(Figure 3-9)

## Discussion

In this study In order to keep the accuracy of the result,we only included randomized controlled trials(RCT) were into the final analysis, and there have two articles described different severity of the hallux valgus deformity, but only one investigator divided the group into three subgroups base on the severity of hallux valgus and reported the outcomes data. So we haven't analysis the subgroups base on the severity of hallux valgus. Although there are a lot of studies reported Scarf Osteotomy or Chevron Osteotomy repaired hallux valgus deformity ,and both treatment have got positive effect on postoperative HVA and IMA, but there are few previous articles compared Scarf Osteotomy and Chevron Osteotomy for hallux valgus deformity, so we established this research to evaluated the difference of the two operations for HVD. Our results show that compared with the Scarf Osteotomy group,Chevron Osteotomy can significantly decreaseed Post-operative HVA;in addition there have no significantly difference between Scarf and Chevron Osteotomy groups in terms of Postoperative IMA,C-IMA/HVA,DMAA,AOFAS and complication incidence. The outcomes indicated that Chevron osteotomy could achieved better HVA degree compared Scarf osteotomy, but in some researches the results showed that scarf osteotomy was expected to correct moderate and severe hallux valgus better than chevron osteotomy.<sup>14,15</sup> Because in our study only two articles described different severity of the hallux valgus deformity, and one investigator divided the group into three subgroups base on the severity of hallux valgus, so we haven't evaluated the difference in moderate and severe hallux valgus, but we thought the classification of hallux valgus is necessary in the future researches which will indicate the effective of the different type of osteotomy procedures.

Hallux Valgus Deformity(HVD) is a common disease which could be associated with persistent foot pain and foot dysfunction, moreover it could increased the risk of others complication such as impaired gait patterns, osteoarthritis (OA) at the first metatarsophalangeal joint (MTPJ), poor coordinated stability and increased risk of falls in older adult.<sup>16</sup> In order to solve these problems hundred techniques have been described for treatment of hallux valgus deformity,it is well known that quality of life (QoL) improves

significantly following hallux valgus surgery.<sup>17,18</sup> And the treatment procedure chosen often depend on the severity of HVD, Kushioka et al established a retrospective observational of 76 rheumatoid arthritis cases (60 patients) followed for a mean of 35.3 months (range, 24to 56 months) through a modified Scarf osteotomy was performed, the results show that there was a significant improvement at final follow-up, in the mean JSSF RA foot and ankle score and the mean JSSF hallux score.<sup>19</sup> And there have others studies considered that chevron osteotomy was also can be a safe method with good clinical outcomes and comparable to traditional open techniques for symptomatic mild-moderate hallux valgus.<sup>20,21</sup> So there is still remains controversial about which is the better procedure for moderate or sever hallux valgus deformity.

The most accepted method of assessing the severity of the hallux valgus deformity involves angular measurements on weight-bearing radiographs, specifically the hallux valgus angle (HVA) and the first-second intermetatarsal angle (IMA).<sup>22,23</sup> AOFAS((American Orthopaedic Foot and Ankle Society) scores have been described in previous reports which could be an effective tool to evaluated the foot function.<sup>24,25</sup> In our study there have only two researches reported preoperative and postoperative AOFAS data, and the result show that there have no significant difference between Scarf and Chevron osteotomy, but there is need more data to support this result in the future.

According to the this meta-analysis of RCT, we were able to believe that Chevron osteotomy could achieved better HVA and C-HVA degree compared Scarf osteotomy. But there are still have some limitations in this meta-analysis. (1) The included studies are describe different severity of the hallux valgus deformity, which may cause bias to the results. (2) The Chevron and Scarf osteotomy procedure is not all the same standard by different surgeons, which affects the final results. (3) The heterogeneity between the each study will also affect the accuracy of the final results. (4) Lack of long-term follow-up outcomes may decrease the reliability of the results. Although this meta-analysis contains many limitations, the study is still powerful enough to guide future clinical work. Multicenter, prospective, randomized control trials with large sample sizes are needed in the future.

## Conclusions

In conclusion, this meta-analysis suggests that compare Scarf osteotomy, Chevron Osteotomy can significantly decrease Post-operative hallux valgus angle (HVA) and other clinical outcomes are similar between the two treatments.

## Abbreviations

HVA:Hallux valgus angle

IMA:Intermetatarsal 1-2 angle

C-HVA:Correction of hallux valgus angle

C-IMA:Correction of intermetatarsal 1-2 angle

DMAA:Distal metatarsal articular angle

AOFAS: American Orthopaedic Foot & Ankle Society

MTPJ:Metatarsophalangeal joint

OA:Osteoarthritis

QoL:Quality of life

RCT:Randomized controlled trial

RRs:Relative risks

Clis:Confidence intervals

## Declarations

-Ethics approval and consent to participate

This is a review study needn't ethic approval and consent to participate

-Consent for publication

All authors consent for publication

-Availability of data and materials

All authors consent for availability of data and materials

-Competing interests

There have no Competing interests

-Funding

This study have no funding

-Authors' contributions

All authors have contributed substantially to the conception, design, analysis, and/or interpretation of the data in this manuscript and will take public responsibility for the content.

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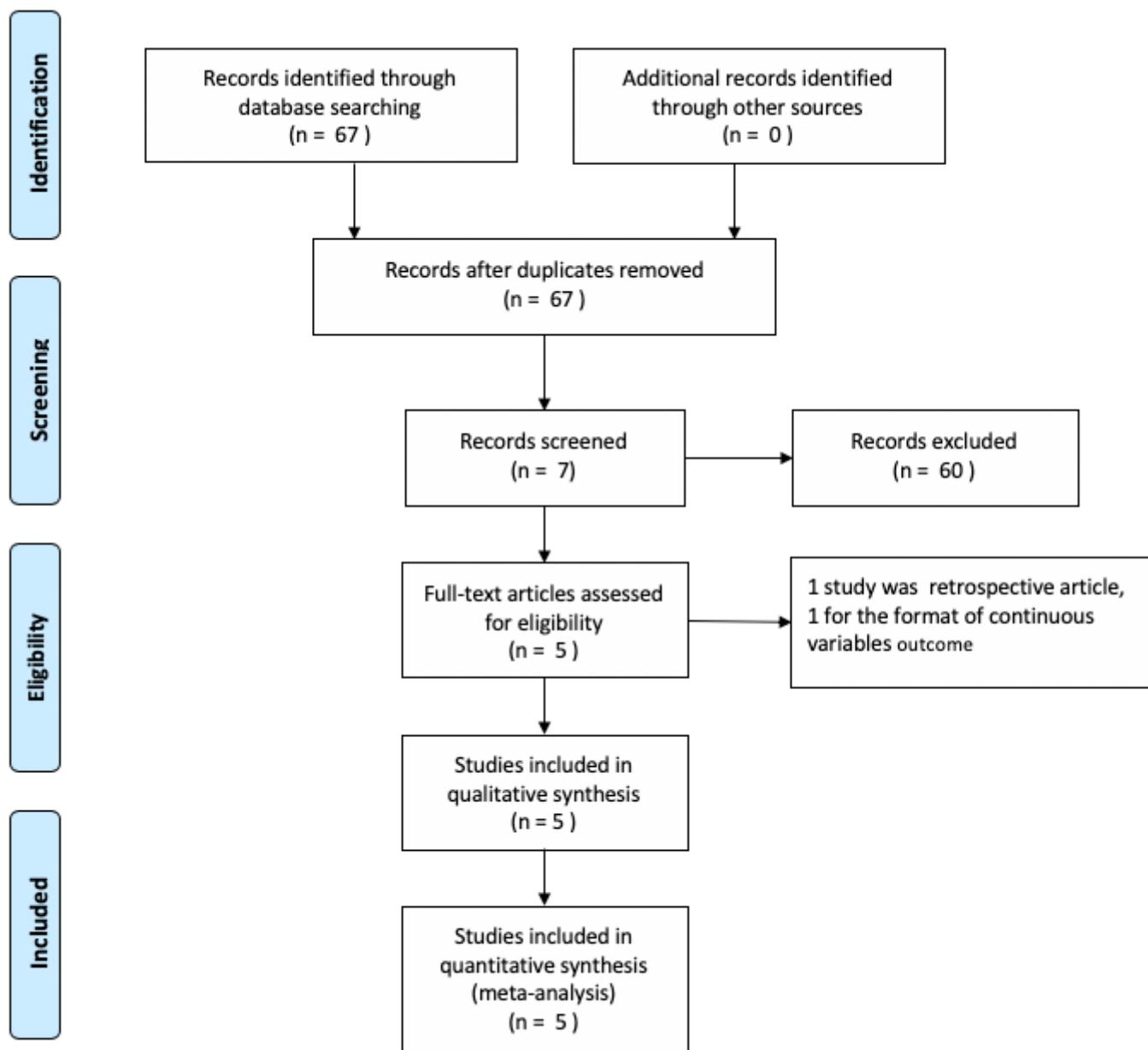
## Tables

Table 1

Study	Country	Scarf	Chevron	Outcomes
Elshazly 2019	Egypt	21	22	HVA,IMA,C-HVA/IMA,complication incident
Deenik 2008	Netherlands	66	70	HVA,IMA,C-HVA/IMA,DMAA,complication incident
Mahadevan 2016	UK	49	60	HVA,IMA,DMAA,complication incident
Lee 2017	Australia	25	25	HVA,IMA,AOFAS,complication incident
Deenik 2007	Netherlands	49	47	HVA,IMA,C-HVA/IMA,AOFAS,complication incident

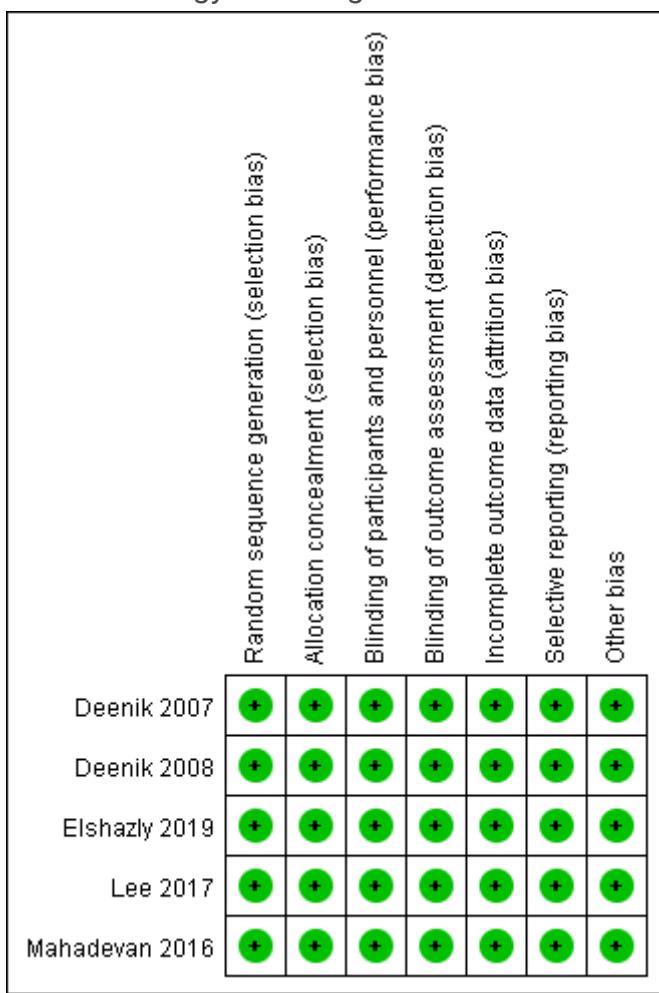
HVA:Hallux valgus angle;IMA:Intermetatarsal 1-2 angle;C-HVA:Correction of hallux valgus angle;C-IMA:Correction of intermetatarsal 1-2 angle'DMAA:Distal metatarsal articular angle;AOFAS: American Orthopaedic Foot & Ankle Society

## Figures



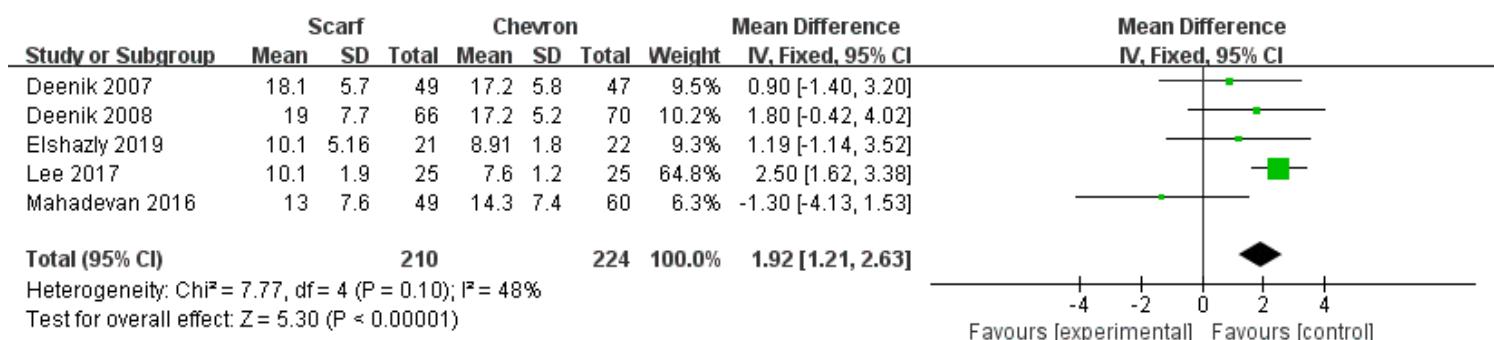
**Figure 1**

Search strategy flow diagram.



**Figure 2**

Summarizes the methodological quality of the selected studies. All of the studies were RCT(Randomized Controlled Trails) with a high level of methodological quality. Thus, the methodological bias of this study was low.



**Figure 3**

Forest plot showing the weighted mean difference in postoperative HVA between Scarf and Chevron osteotomy.

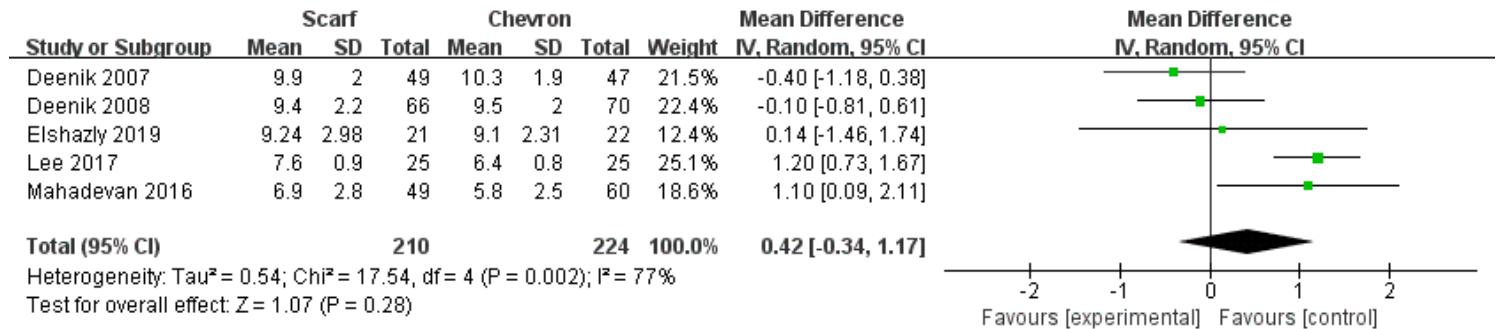


Figure 4

Forest plot showing the weighted mean difference in postoperative IMA between Scarf and Chevron osteotomy.

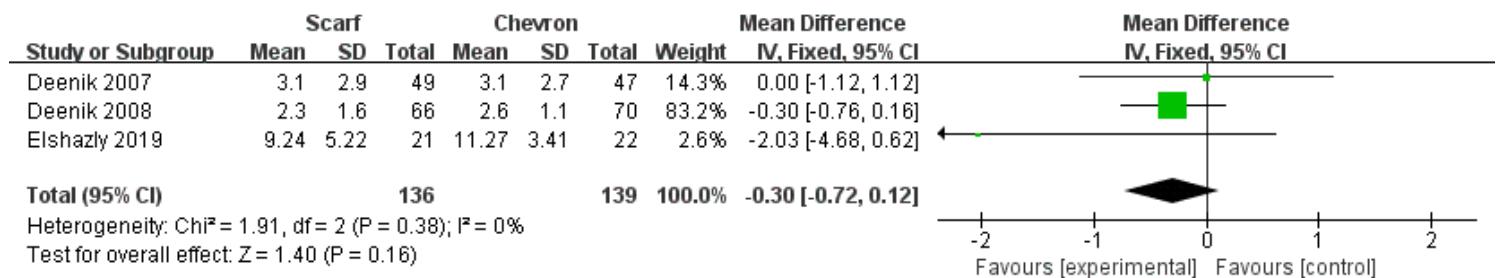


Figure 5

Forest plot showing the weighted mean difference in postoperative C-IMA between Scarf and Chevron osteotomy.

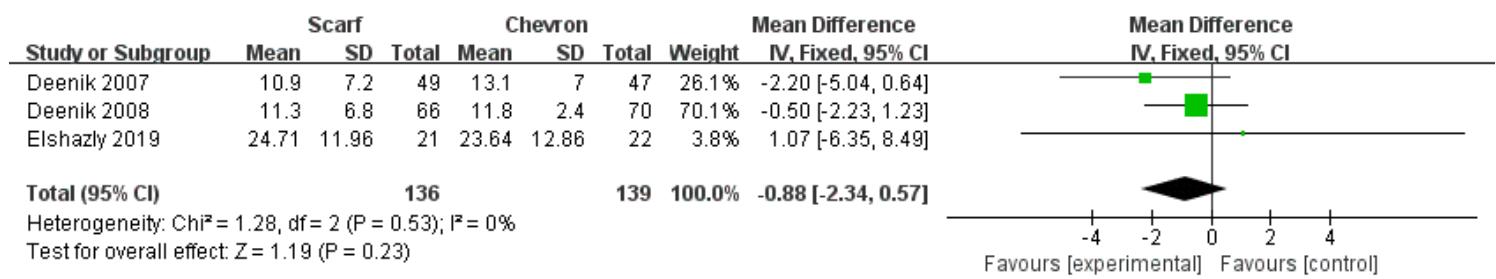
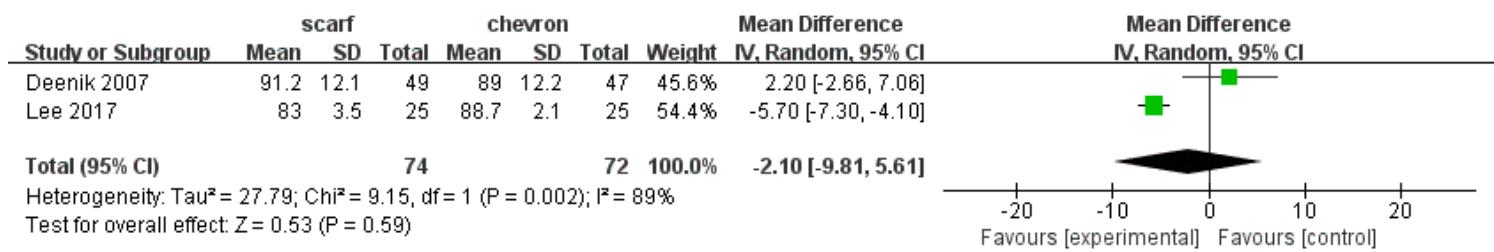


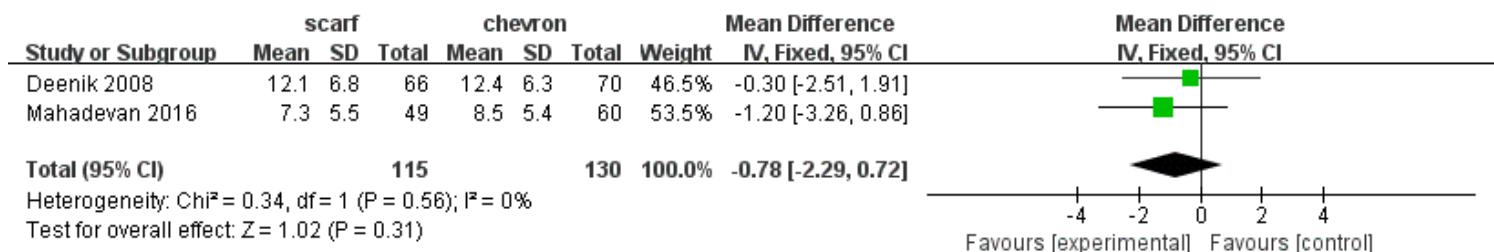
Figure 6

Forest plot showing the weighted mean difference in postoperative C-HVA between Scarf and Chevron osteotomy.



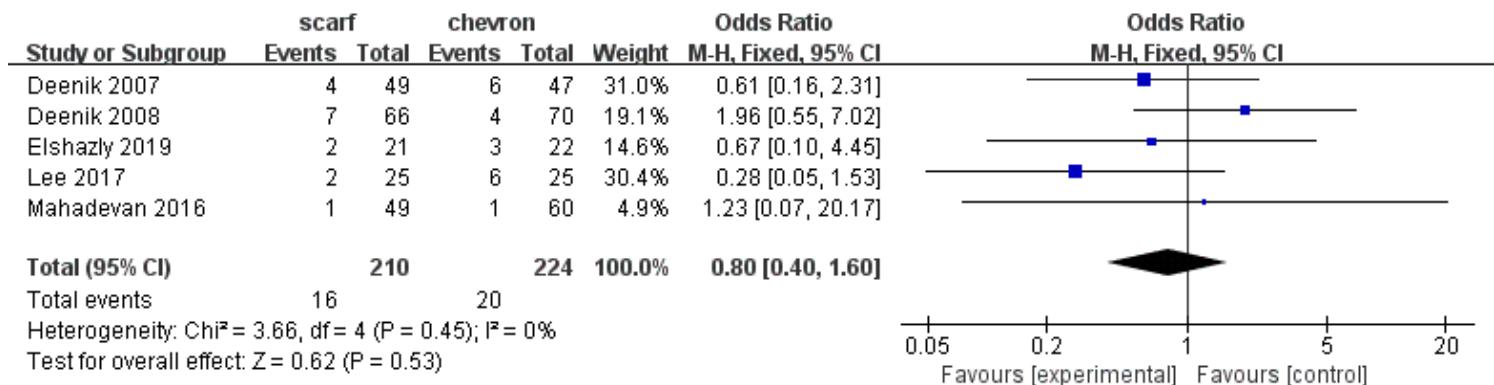
**Figure 7**

Forest plot showing the weighted mean difference in postoperative DMAA between Scarf and Chevron osteotomy.



**Figure 8**

Forest plot showing the weighted mean difference in postoperative AOFAS between Scarf and Chevron osteotomy.



**Figure 9**

Forest plot showing the OR difference in complication incidence between Scarf and Chevron osteotomy.

## Supplementary Files

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