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ORIGINAL STUDY

Distal Chevron versus Scarf for hallux valgus. A comprehensive meta-analysis of comparative studies

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An amazing number of surgical techniques have been reported to treat hallux valgus (HV) deformity. The most two popular are the Chevron and the Scarf osteotomies. Both claim to generate good correction of the deformity. The aim of this meta-analysis is to look for significant outcome differences between both treatments and their variants. A comprehensive search on Medline, Embase, Scopus, Web of Science, Cochrane Library and Google Scholar was conducted. Literature search, data extraction, and quality assessment were conducted by two independent reviewers. The outcomes included radiological angular parameters and complications. Nine studies including 630 patients (689 foot : 320 Chevron- or variants and 286 Scarf), met the inclusion criteria. Comparing all variant types of Chevron to Scarf showed no difference for all outcomes. However, subgroup analyses demonstrated the following for the HV angle (HVA) correction : a) Scarf generated significantly better correction when compared to classical Chevron and (P < 0.0001), b) significance was lost when Scarf was compared to the extended Chevron with a long plantar limb, c) mild significance found in favor of percutaneous Chevron + Akin versus Scarf + Akin (p = 0.01), d) 3 cases (1.3%) of osteonecrosis of the first metatarsal head post Chevron and none after Scarf. This meta-analysis demonstrated that Scarf produced better HV angle correction than open classical Chevron. However, a Chevron with an extended plantar limb yielded similar HV angle correction compared to Scarf. This is likely due to the higher potential of lateral translation provided by the broader surface of a long plantar limb. The results of the small pooled sample of the subgroups of percutaneous Chevron versus Scarf could have been biased by the complementary Akin osteotomy.

Keywords : hallux valgus ; chevron osteotomy ; scarf osteotomy.

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INTRODUCTION

Hallux valgus (HV) is considered to be the most common pathology of the big toe with an increasing prevalence in the older population *(22).* It has been reported to affect between 12% and 65% of the

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population above 65 years of age (3,22,28). Hallux valgus negatively impacts the quality of life of affected individuals (17). More so it is a big burden on healthcare resources with more than 200 000 surgeries a year in the US to correct this forefoot pathology (30). It is now widely accepted that surgical correction is the most effective in treating this deformity, with conservative management acting only as symptomatic relief (31). The goals of surgery are to correct the deformity, improve MTP joint congruence and functional outcome (33).

That being said, more than 100 procedures have been described throughout the years for the treatment of symptomatic HV (5). Two of the most popular techniques are the Chevron and the Scarf osteotomies. The distal Chevron osteotomy has been generally recommended for mild to moderate deformity (32). It consists of a V-shaped horizontal osteotomy of the distal 1st metatarsal, and is considered to be a stable osteotomy with rapid bone healing and a minimal risk of shortening (6). Some of its disadvantages are a high risk of osteonecrosis of the metacarpal head, due to injury of the volar plate and an insufficient rate of correction (21). In order to broaden its clinical application for moderate to severe deformities, modified versions of Chevron osteotomy were described in particular that with a longer plantar limb (4,26). Recently, good results were reported following Chevron using percutaneous and minimally invasive surgeries with faster recovery rates and lower post-operative pain (15).

On the other hand, the Scarf osteotomy gained popularity as a more appropriate technique for moderate to severe deformities. It is a horizontal Z-osteotomy through the shaft of the metatarsal, creating two fragments that can then be translated to obtain correction in three dimensions (1). Its main disadvantages are being a more technically demanding procedure with extensive soft tissue dissection (27). In 2004, a Cochrane review concluded that no specific procedure is superior to the other when correcting a hallux valgus deformity (13) but no included study compared Chevron to Scarf. A systematic review in 2012 (29) concluded that the scarf osteotomy provides greater correction of the 1st-2nd inter-metatarsal angle (IMA). However, the findings were based on very low to low quality of evidence ; 31 studies where 30 were case-series and only one comparative. Based on 3 RCTs and one retrospective comparative study, a more recent meta-analysis reported that the effects of Chevron osteotomy and Scarf osteotomy for HV are comparable (20). However, the authors included heterogeneous studies, combined distal and proximal Chevron for comparison, grouped long-term to short term follow-ups and reported post-operative values rather than correction values, with no subgroup analyses for all above variables. Additionally, other studies comparing the efficacy of both techniques, mainly in relation to the correction of the hallux valgus angle (HVA) and 1st 2nd inter-metatarsal angle (IMA) failed to be located for inclusion.

Therefore, the goal of this meta-analysis is to collate all types of comparative studies in order to comprehensively compare the outcomes of both techniques in terms of radiological corrections, in addition to functional status and complications.

MATERIALS AND METHODS

An electronic search strategy has been formulated, from inception till Dec 2018, with the following databases : Medline, Embase, Scopus, Web of Science, Cochrane Library and Google Scholar. Few Boolean terms were used to locate the relevant studies, such as : [(Chevron AND Scarf) AND ‘’hallux valgus’’]. No date or language limitations were imposed.

Inclusion criteria were as following : studies with a comparative design, studies reporting comparison of any type of Chevron osteotomy versus any type of Scarf osteotomy, studies reporting the primary outcomes. Case series, case reports and reviews were excluded. When an additional procedure such as Akin osteotomy was reported, studies were included if such was performed equally in both group of comparison.

The primary outcomes were set to be the correction values of hallux valgus angle (HVA) and inter-metatarsal angle (IMA). Correction values of the Distal Metatarsal Articular Ankle (DMAA), the visual analogue score (VAS), the American

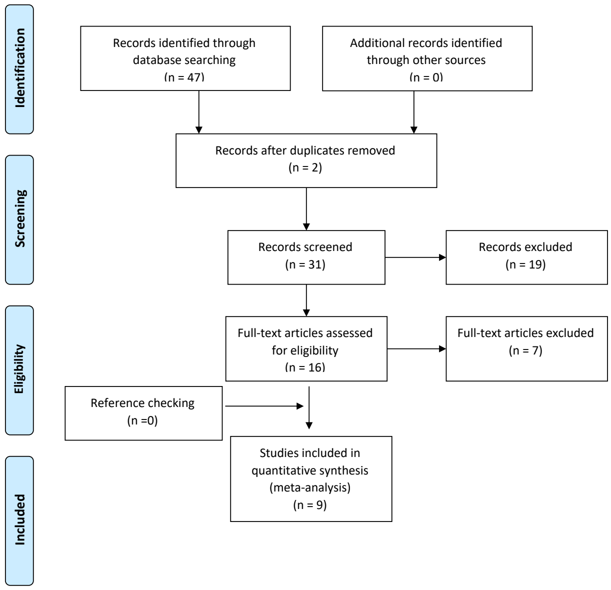

Figure 1. — PRISMA Flow Diagram

Orthopaedic Foot & Ankle Society (AOFAS) score, and complications were the secondary outcomes.

Statistical analysis was run using StatsDirect (Cambridge, UK). First the pooled values of all pre, post-operative and correction outcomes were calculated and reported. Then, an overall effect size meta-analysis was conducted for correction values outcomes, including all studies. Sensitivity analysis via subgroup analyses was planned based on the type of Chevron osteotomy.

This review followed the (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) PRISMA guidelines *(25).* The quality of the studies was assessed to detect potential sources of bias from the study design using The Joanna Briggs Institute (JBI) critical appraisal tools. Both, the JBI critical appraisal checklist for randomized control trials (RCTs) and the JBI critical appraisal checklist for case-control studies were used accordingly *(24).*

RESULTS

In total, 9 studies met the inclusion criteria and were subject to quantitative analysis *(2,9-12,16, 18,19,33).* Five studies were randomized clinical trials (RCTs) and the remaining four had a retrospective comparative design. All studies compared distal Chevron osteotomy or one of its variants to Scarf osteotomy (Table I). The later study of Deenik et al. *(10)* published in 2008 could have included a certain number of same patients of the earlier one *(9).* Since we were not able to remove the doubt, an additional sensitivity analysis has been conducted excluding the earlier study, published in 2007.

The pooled sample patient size was of 630 patients including 689 foot (320 Chevron and 286 Scarf). Six studies reported the age of their samples yielding a mean age of 48.1 ±7.4 years. Surgical time was reported only by three studies ; mean time was 43.7 ±19.5min and 51.5 ±20.5min for Chevron and Scarf, respectively (p = 0.6). The mean follow-up period was of 18.1 ±8.7 months. No significant differences in demographic variables neither in pre-operative outcome values were found between comparison groups in all studies. Since the study of Volpat et al. *(33)* included unequal additional Akin procedure, only the subgroup who did not had Akin osteotomy was reported and analyzed. The study of ElShazley et al. *(11)* reported an additional Akin osteotomy in 4 patients in each group. The described technique for Scarf osteotomy was similar between studies.

The quality of both RCTs and retrospective comparative studies was at least good ; there was no ‘’No’’ answer in any study (Tab. II and III).

Three studies compared open Chevron vs. Scarf, two others compared percutaneous Chevron + Akin vs. Scarf + Akin and another two compared open extended Chevron vs. Scarf.

Correction results are shown in table IV. Meta-analytical results are summarized in Table V. The overall analysis showed no significant differences for all outcomes when comparing any type of Chevron vs. Scarf. However, four subgroup analyses were conducted.

The first between subgroups of open Chevron and Scarf. Three studies reported such comparison totalizing 265 interventions *(9,10,12).* Only HVA and IMA were available for analysis. A significantly better HVA correction was found following Scarf osteotomy (P < 0.0001). No significance was noted between both methods in IMA correction. Similar results were found when excluding the earlier study of Deenik et al. *(9)*, which was published in 2007,

Table I. — Characteristics of the included studies

Studies	Study comparative type	Comparison	Sample size (patients)	Total number of interventions	Sample size (feet)		Age		Surgical time (min)		Mean follow-up (months)
					Chevron	Scarf	Chevron	Scarf	Chevron	Scarf	
Deenik et al., 2007	RCT	Open Chevron vs. Scarf	83	96	47	49	43	45	24 ±5.8	29±6.7	27 ±7
Deenik et al., 2008	RCT	Open Chevron vs. Scarf	115	136	70	66	NA	NA	NA	NA	31.2
Fakoor et al. 2014	Retrospective comparative	Open Chevron vs. Scarf	33	33	23	10	35.6	41.7	NA	NA	12
Lai et al., 2018	Retrospective comparative	Percutaneous Chevron + Akin vs. open Scarf + Akin	97	97	29	58	54.3 ±12.8	54.3 ±12.7	44.3 ±6.1	56.6 ±11.8	24
Lee et al., 2017	RCT	Percutaneous Chevron + Akin vs. open Scarf + Akin	50	50	25	25	52.6	53.4	NA	NA	6
Mahadevan et al., 2016	RCT	Open Extended Chevron vs. Scarf	84	109	60	49	50.7 ±14.1		NA	NA	12
Vopat et al., 2013	Retrospective comparative	Open Extended Chevron vs. Scarf	46	46	17	29	58.7	56.5	NA	NA	7.3
Elshazly et al., 2018	RCT	Open Extended chevron vs. Scarf	43	43	22	21	36±12.16		63±8.36	69±8.38	25.9 + 1.84
Choi et al., 2017	Retrospective comparative	Open Chevron vs. Scarf	79	79	27	52	44.3±14.6	47.5±13.2	NA	NA	16.1 ±7.7 vs. 19.8 ±14.2

Table II. — JBI Critical Appraisal Checklist for Randomized Controlled Trials

Checklist	Deenik et al., 2007	Deenik et al., 2008	Lee et al., 2017	Mahadevan et al., 2016	Elshazly et al., 2018
1. Was true randomization used for assignment of participants to treatment groups?	Unclear	Yes	Unclear	Yes	Yes
2. Was allocation to treatment groups concealed?	Unclear	Unclear	Unclear	Yes	Unclear
3. Were treatment groups similar at the baseline?	Yes	Yes	Yes	Yes	Yes
4. Were participants blind to treatment assignment?	Unclear	Unclear	Unclear	Yes	Unclear
5. Were those delivering treatment blind to treatment assignment?	NA	NA	NA	NA	NA
6. Were outcomes assessors blind to treatment assignment?	Yes	Yes	Yes	Yes	Yes
7. Were treatment groups treated identically other than the intervention of interest?	Yes	Yes	Yes	Yes	Yes
8. Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed?	Yes	Yes	Yes	Yes	Yes
9. Were participants analyzed in the groups to which they were randomized?	Yes	Yes	Yes	Yes	Yes
10. Were outcomes measured in the same way for treatment groups?	Yes	Yes	Yes	Yes	Yes
11. Were outcomes measured in a reliable way?	Yes	Yes	Yes	Yes	Yes
12. Was appropriate statistical analysis used?	Yes	Yes	Yes	Yes	Yes
13. Was the trial design appropriate, and any deviations from the standard RCT design (individual randomization, parallel groups) accounted for in the conduct and analysis of the trial?	Unclear	Unclear	Unclear	Yes	Unclear

JBI: Joanna Briggs Institute, NA: not applicable

Table III. — JBI Critical Appraisal Checklist for Case Control Studies

Checklist	Vopat et al., 2013	Fakoor et al. 2014	Choi et al., 2017	Lai et al., 2018
1. Were the groups comparable other than the presence of disease in cases or the absence of disease in controls?	Yes	Yes	Yes	Yes
2. Were cases and controls matched appropriately?	Yes	Yes	Yes	Yes
3. Were the same criteria used for identification of cases and controls?	Yes	Yes	Yes	Yes
4. Was exposure measured in a standard, valid and reliable way?	Yes	Yes	Yes	Yes
5. Was exposure measured in the same way for cases and controls?	Yes	Yes	Yes	Yes
6. Were confounding factors identified?	Yes	Yes	Yes	Yes
7. Were strategies to deal with confounding factors stated?	Yes	Yes	Yes	Yes
8. Were outcomes assessed in a standard, valid and reliable way for cases and controls?	Yes	Yes	Yes	Yes
9. Was the exposure period of interest long enough to be meaningful?	Yes	Yes	Yes	Yes
10. Was appropriate statistical analysis used?	Yes	Yes	Yes	Yes
Total of ''No''	0	0	0	0

JBI: Joanna Briggs Institute

Table IV. — Correction values

Studies	**HVA**		**IMA**		**DMAA**		**VAS**		**AOFAS**	
	Chevron	Scarf	Chevron	Scarf	Chevron	Scarf	Chevron	Scarf	Chevron	Scarf
Deenik et al., 2007	13.1 ±7.0	10.9 ±7.2	3.1 ±2.7	3.1 ±2.9	NA	NA	NA	NA	40.5 ±15.4	43.8 ±17.9
Deenik et al., 2008	13.3 ±6	21 ±7.3	3.9 ±2.2	3.7±2.4	0.6±0.6	0	NA	NA	40	41
Fakoor et al. 2014	16.17±3.7	18±2.1	4.5±2.4	6.3±0.9	NA	NA	NA	NA	NA	NA
Lai et al., 2018	21.0 ± 7.2	16.8 ± 9.1	4.3 ± 2.9	5.8 ± 3.6	NA	NA	3.3±2.4	4.5±2.05	28.8 ±17.2	35.2±14.2
Lee et al., 2017	23.8±1.7	21.1±3	9.3±0.9	8.1±1.2	NA	NA	6.8±1.2	6.4±1.4	27.4±2.7	24.5±3.9
Mahadevan et al., 2016	18±7.9	16.5±7.6	9.4±2.8	7.4±2.9	8±5.4	9.3±6.4	NA	NA	NA	NA
Vopat et al., 2013 (non-Akin sample)	23.8	25.1	10.5	11.5	4.4	4.5	NA	NA	NA	NA
Elshazly et al., 2018	23.6 ±12.8	24.7 ±11.9	11.3 ±3.4	9.2 ±5.2	NA	NA	NA	NA	NA	NA
Choi et al., 2017	15.8 ±10.9	16.5 ±6.2	5.0 ±3.7	7.2 ±2.8	NA	NA	NA	NA	24.5 ±4.1	23.7 ±4.2

yielding an HVA correction effect size of 1.03 (95% CI = 1.361 to 0.707, P < 0.0001) in favor of Scarf.

The second between percutaneous Chevron +Akin and Scarf + Akin. Two studies including 147 interventions were analyzed *(16,18)*. A moderate significance (p = 0.01) in favor of percutaneous Chevron was found for the HVA correction outcome. The differences in the remaining outcomes (IMA, VAS, AOFAS) were non-significant.

The third between extended open Chevron and Scarf. Four studies with a total of 277 interventions were subject to analysis *(2,11,19,33)*. Only HVA, IMA and DMMA were available for analysis and none showed significant difference between both methods.

The fourth between open Chevron + extended open Chevron and Scarf. The 7 studies included 542 interventions. Effect size meta-analysis yielded significantly better HVA correction following Scarf (p = 0.006) while no significance was noted for the IMA correction outcome.

Three studies reported post-operative infection ; 3/123 (2.4%) following Chevron and 4/153 (2.6%) after Scarf *(9,16,18)*. Five studies reported the prevalence of osteonecrosis of the first metatarsal head ; 3/228 (1.3%) post Chevron and none after Scarf *(9,10,11,16,19)*. Mahadevan et al. reported one case of hallux varus following each method *(19)*. None of the complications showed significant differences between the two methods.

Table V. Meta-analytical results

Variables	D (effect size)	CI 95%	I^2	P
Any type of Chevron vs. Scarf				
HVA	-0.01	-0.458 to 0.436	87.1%	0.9
IMA	-0.003	-0.387 to 0.393	83%	0.9
DMAA	0.58	-0.990 to 2.156	NA	0.4
VAS	-0.14	-0.971 to 0.693	NA	0.7
AOFAS	0.08	-0.410 to 0.569	77.2%	0.7
Open Chevron vs. Scarf				
HVA	-0.5	-0.754 to -0.247	92.8%	**<0.0001**
IMA	-0.04	-0.283 to 0.204	58.1%	0.7
Percutaneous Chevron +Akin vs. Scarf + Akin				
HVA	0.75	0.171 to 1.342	NA	**0.01**
IMA	0.12	-0.233 to 0.485	NA	0.5
VAS	-0.2	-0.561 to 0.141	NA	0.2
AOFAS	0.06	-0.293 to 0.416	NA	0.7
Open extended Chevron vs. Scarf				
HVA	-0.01	-0.251 to 0.230	0%	0.9
IMA	0.04	-0.664 to 0.754	87.2%	0.9
DMAA	-0.17	-0.491 to 0.148	NA	0.3
Open Chevron or extended Chevron vs. Scarf				
HVA	-0.24	-0.418 to -0.068	84%	**0.006**
IMA	0.02	-0.145 to 0.201	80.4%	0.1

DISCUSSION

The debate over the efficacy of each technique has been the subject of many reports. However, the majority of the published studies were case-series. When taken individually, some the few published comparative studies were in favor of scarf where others were inconclusive. This meta-analysis demonstrated that Scarf technique could be better than open classical Chevron osteotomy when reducing the hallux valgus angle. Interestingly, when analyzing the extended Chevron osteotomy, significance for the HVA outcome was lost compared to Scarf. Combining open classical and extended Chevron versus Scarf yielded a slightly lesser p-value, but still the difference was highly significant in favor of Scarf. None of the other outcomes showed statistical difference between any types of any method. On the other hand, the HVA results drawn from the comparison of percutaneous Chevron +Akin vs. Scarf + Akin in favor of the former could have been biased via the additional effect of the Akin procedure. The medial osteotomy correction at the base of the first phalanx could directly affect the HVA angle. In fact, none of the two studies reported the amount of medial bone removal in the Akin procedure. In addition, one study used compressive screws while the other used staples. Therefore, the results yielded from the pooling of the 2 relevant studies should be taken with caution. Further large-sampled randomized studies are needed.

The findings are in contrast with the recently published meta-analysis of Ma et al. on the curative effect of scarf osteotomy and distal chevron osteotomy on patients with HV *(20).* Their study was published after we completed data collection and analysis of our study. These authors included 4 prospective controlled studies bearing many heterogeneities. First, they included data related to the proximal Chevron osteotomy results instead of the distal data set from Choi et al. *(2)* study. Second, an open extended plantar Chevron, and not the classical type of Chevron as reported by others, was used by Mahadevan et al. *(19).* Third, while their other 3 studies reported results after 1-2 years of follow-up, Ma et al. *(20)* choose to include Jeuken's et al. *(14)* study which is a report of the long term results (13.8 years) of the previous study of Deenik et al. *(10)* that reported results at a follow-up of 2.6 years. Fourth, they compared the post-operative values rather than the more appropriate correction values for the outcomes. Based on all above, we argue that such level of inhomogeneity in the inclusion criteria, data collection, follow-up duration and outcome choice would have introduced serious bias to their results. The multiple sensitivity analyses reported in their review, all performed by omitting one study apiece and that for every outcome, could not balance such heterogeneity.

On the other hand, the results of our review could bring some explanations on the outcome differences between Chevron and Scarf. The findings imply that the length of the plantar limb could be a major element in HVA correction. When the plantar arm of the Chevron osteotomy was extended proximally, significant HVA difference versus Scarf was no more. The long plantar limb requires an oblique cut from medio-dorsal to plantar lateral through the distal third of the metatarsal shaft. Therefore, with a broader surface compared to that generated by an epiphyseal cut such as with the classical Chevron, the amount of lateral translation could be extended further yielding better correction. Such increased lateral translation could be comparable with that observed via Scarf, thus producing similar results.

It is worthy to note that no method was superior to any other technique in relation to the correction of IMA. Though the IMA, in addition to HVA, was found to be correlated with the clinical deformity of HV *(7,23)*, our results suggest that only the HVA correction value is to be considered when comparing the efficacy of HV surgical treatment. This statement supports the conclusion of Deenik et al. *(10)*, that the preoperative HVA was the main radiological predictor for correction of hallux valgus *(8)*. It contradicts the findings of Smith et al.'s review, comparing case-series of both methods, which reported a statistically significant 0.88° increase in the correction of the IMA in favor of the scarf osteotomy.

The limitations of this review are mainly those related to the quality of the included studies. Not all the studies had a randomized design ; however, more than half (55.5%) were RCTs. Further, the basic demographics of the included subjects in the retrospective comparative studies were similar between groups of each study. Subgroup analyses of this review were based on smaller sample sizes ; however and besides that of the percutaneous comparison, the samples for all other comparisons varied between 265 and 542 interventions. Though three cases of osteonecrosis of the first metatarsal head were reported following Chevron, large observational studies could be more appropriate to estimate the prevalence of such complication.

In sum, the Scraf osteotomy could offer better correction than open classical Chevron for the treatment of hallux valgus deformity. With a longer plantar limb, the extended open Chevron yielded similar correction outcomes to Scarf technique. The hallux valgus angle could be the only appropriate outcome to be considered when comparing the efficacy of different surgical methods in treating hallux valgus.

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Pre-operative extracted data

Studies	HVA		IMA		DMAA		VAS		AOFAS	
	Chevron	Scarf	Chevron	Scarf	Chevron	Scarf	Chevron	Scarf	Chevron	Scarf
Deenik et al., 2007	30.4 ±7.7	28.9 ±7.7	13.4 ±3.2	12.8 ±3.2	NA	NA	NA	NA	48.4 ±13.6	47.4 ±13.5
Deenik et al., 2008	30.5 ±6.7	30.0 ±6.9	13.4 ±2.4	13.1 ±2.6	13.0 ±6.9	12.1 ±6.8	NA	NA	46	47
Fakoor et al. 2014	25 ±4.2		11 ±2.6		NA	NA	NA	NA	NA	NA
Lai et al., 2018	29.9 ±8.5	30.6 ±8.4	14.6 ±3.9	14.6 ±3.3	NA	NA	4.0 ± 2.9	4.9 ±2.6	58.6 ±16.6	53.2 ±14.6
Lee et al., 2017	31.4 ±2.1	31.2 ±4.1	15.6 ± 1.0	15.7 ± 1.4	NA	NA	7.1 ± 1.5	6.9 ± 1.7	61.3 ±3.2	58.5 ±4.3
Mahadevan et al., 2016	32.3 ±8.3	29.5 ±7.6	15.2 ±3.1	14.3 ±2.9	16.5 ±5.3	16.6 ±7.3	NA	NA	NA	NA
Vopat et al., 2013 (All sample)	31.5	33.6	13.0	14.9	9.8	8.2	NA	NA	NA	NA
Elshazly et al., 2018	32.5 ±12.8	34.8 ±13.4	20.3 ±3.5	18.5 ±4.5	NA	NA	NA	NA	NA	NA
Choi et al., 2017	27.0 ±10.1	29.3 ±5.5	12.6 ±2.3	14.4 ±2.7	NA	NA	NA	NA	63.7 ±4.7	64.8 ±5.0

Post-operative extracted data

Studies	HVA		IMA		DMAA		VAS		AOFAS	
	Chevron	Scarf	Chevron	Scarf	Chevron	Scarf	Chevron	Scarf	Chevron	Scarf
Deenik et al., 2007	17.2 ±5.8	18.1 ±5.7	10.3 ±1.9	9.9 ±2.0	NA	NA	NA	NA	89.0 ±12.2	91.2 ±12.1
Deenik et al., 2008	17.2 ± 5.2	19.0 ± 7.7	9.5 ± 2.0	9.4 ± 2.2	12.4 ± 6.3	12.1 ± 6.8	NA	NA	86	88
Fakoor et al. 2014	NA	NA	NA	NA	NA	NA	2.7±2.1	1.4±1.07	NA	NA
Lai et al., 2018	8.8 ± 5.9	13.8 ± 7.6	10.3 ± 3.1	8.8 ± 3.4	NA	NA	0.7 ± 1.9	0.4 ± 1.5	87.4 ± 17.8	88.4 ± 13.8
Lee et al., 2017	7.6 ± 1.2	10.1 ± 1.9	6.4 ± 0.8	7.6 ± 0.9	NA	NA	0.3 ± 0.9	0.5 ± 1.1	88.7 ± 2.1	83.0 ± 3.5
Mahadevan et al., 2016	14.3±7.4	13.0±7.6	5.8±2.5	6.9±2.8	8.5±5.4	7.3±5.5	NA	NA	NA	NA
Vopat et al., 2013 (All sample)	7.2	6.4	4.3	6.0	5.61	3.21	NA	NA	NA	NA
Elshazly et al., 2018	8.91±1.80	10.10±5.16	9.10±2.31	9.24±2.98	NA	NA	NA	NA	NA	NA
Choi et al., 2017	12.1 ±7.4	12.9 ±5.9	7.7 ±4.1	7.2 ±2.7	NA	NA	NA	NA	88.2 ±3.6	88.5 ±3.5